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A Bibliometric Analysis (2008 to 2023) on Legume Research Journal-Uncovering Scientific Impact

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ABSTRACT

Background: A potent instrument for quantitative evaluation in the context of academia and research is bibliometric analysis. It offers data-driven insights that support qualitative evaluations, facilitating decision-making and advancing knowledge of the academic environment as a whole. With this back ground work we selected legume research journal as on interest and performed bibliometric analysis.

Methods: Bibliometric analysis of legume research is a systematic method of evaluating scholarly publications and their impact within a specific field of study from 2008 to 2023 (15 years). The analysis was done by using Bibliometrix tool using R Studio and R software. The study was conducted during July-November, 2023 at Tamil Nadu Agricultural University, Coimbatore, India.

Result: Legume research journal have an h-index of 18, g index of 26 and h index of 1.3 based on local source impact. The analysis revealed that it has 2076 documents with growth rate of 7.37. Higher annual production was in 2022 with 236 articles and Tamil Nadu Agricultural University highly contributing institute. But according to author impact h index was for Kumar R with 9 with 11 publications in the year 2022 with citation score of 1.5. The most frequent word used in 'key word plus' was *Cicer arietinum* (52 times) appeared in 10% of the documents and changes in the trend topics from bacteria in 2008 to *Lens culinaris* in 2023. Dhakal Y (58) has the highest global cited documents. *Cicer arietinum*, *Vigna mungo* and *Pisum sativum* were the basic themes. Gomez KA and Jakson ML was had highest co citation. India is most cited country with 3,783 citations and highest in production with 6,414 articles. Bangladesh to Malaysia (Frequency @12) have strongest collaboration between them. The bibliometric analysis concludes that there is an increasing interest in the study of legumes, which is consistent with the knowledge of the value of legumes for nutrition and sustainable agriculture. To further our understanding in these important areas, future research should investigate the influence of climate change on legume production, use multidisciplinary approaches and solve identified gaps.

Key words: Bibliometric analysis, Citations, H index, Legume research, Word frequency.

INTRODUCTION

ARCC Journals (Agricultural Research Communication Centre) is a consortium of agricultural and animal research centres and institutes based in India. Established in 1967, the Organization′s editorial board comprises seasoned scientists from around India. Its goal is to promote interaction and cooperation amongst research institutes that specialize in disciplines such as dairy, foods, agriculture, veterinary medicine and allied fields. Since its establishment, ARCC has published scholarly periodicals, beginning with the ARCC Journal of Indian Journal of Agricultural Research and Indian Journal of Animal Research. ARCC has expanded its publishing endeavors throughout the years to encompass multiple more scholarly periodicals. Legume Research has been started in 1976 as a half-yearly publication and later changed to Quarterly. The journal Legume Research covers the fields/ technologies/categories associated with Plant Science (Q2), Soil Science (Q2) and Agronomy and Crop Science (Q2). The Agricultural Research Communication Centre is the publisher. Legume Research's total ranking is 12698. This journal is ranked 0.391 by SCImago Journal Rank (SJR). An indicator that gauges a journal′s scientific influence is SCImago Journal Rank. It considers both the volume of citations a publication gets and the importance of the journals supplying these citations. Its impact score is 0.84. The h-index for this journal is 18. Q2 is the optimal quartile for this journal.

Three steps were engaged in the bibliographic analysis in the study domain: (a) gathering connected works, (b) selecting pertinent works and (c) carefully reviewing and analyzing state-of-the-art related works. Despite their associations, the databases Scopus and WoS (Web of Science) index different journals and

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occasionally obstruct the indexing of journals (Chadegani *et al.*, 2013). One of the biggest abstract and citation databases covering a wide range of subjects is Scopus. As a result, the Scopus database includes more topics that WoS might not have.

MATERIALS AND METHODS

Bibliometric analysis is a research methodology that focuses on the academic publication outputs from databases such as WoS and Scopus to gain insight into worldwide research trends in a given sector. The study was conducted between July, 2023 and November, 2023 at Tamil Nadu Agricultural University, Coimbatore-3. As a result, this method distinguishes between two categories of scholarly study that mainly describe the findings of a particular topic: review papers and research articles. Analysed by using R software (https://cran.r-project.org/src/base/R-4 version 4.3.2). This study represents a bibliometric analysis using a bibiloshiny application with the database downloaded from Scopus.com only not from any other sources.

Data source

Data mining was done with the Scopus database for the period between 2008 and 2023. This study's primary focus was research articles published in the ISSN 0250-5371 Legume Research journal. The most recent publication was in 2023, with 2051 research papers (98.8%) and 25 review articles (1.2%) and the oldest publication was in 2008. It is noteworthy that this method - which utilizes the author's distinct ID-is thought to be the most appropriate for obtaining the most precise information about their outputs. A writer's profile is thought of as their financial roadmap toward publishing. Data for the single country publication (SCP) was located by searching for a specific country using a code as the affiliation country.

When looking at the main theme, the author, source, subject matter, year, document type, country, and association were all taken into account. For ranking purposes, this study has employed CiteScore, h-index, total citations (TC) and total publication (TP). Table 1 provided an overview of the Legume Research journal.

Stages of bibliographic analysis

It is a 5-step process as explained in Fig 1.

RESULTS AND DISCUSSION

Annual scientific production

The information shows (Fig 2) how many articles were released each year between 2008 and 2023. It indicates a cyclical pattern in the work of scholars. The quantity of articles produced has no discernible pattern. Greatest in 2022 with 236 articles and lowest in 2011 with 59 articles. This information points to the possibility of changes in research goals or publication patterns over time, which could be brought about by a variety of variables including financing, trends in the field, or world events that have an impact on academic output.

Average citations per year

The information in the Table 2 shows the "Legume research Journal" average number of citations annually from 2008 to 2023. It illustrates a noteworthy pattern in the influence

Table 1: Brief summary of Legume Research journal (2008-2023).

Description	Results
Main information about data	
Time span	2008-2023
Sources (Journals, Books, *etc*)	1
Documents	2076
Annual growth rate %	7.37
Document average age	5.56
Average citations per doc	3.519
Refrences	42279
Document contents	
Keywords plus (ID)	213
Author's keywords (DE)	4133
Document types	
Article	2051
Review	25
Authors	
Authors	5230
authors of single-authored docs	67
Authors collaboration	
Single-authored docs	80
Co-authors per Doc	4.11
International co-authorships %	3.95

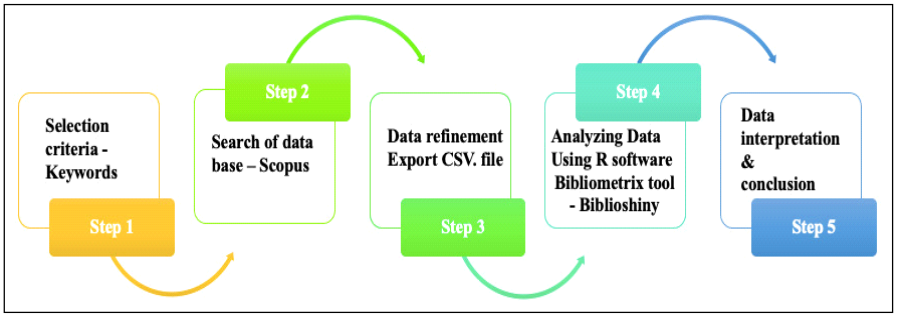


Fig 1: Stages of performing bibliographic analysis.

of journal citations. The average number of citations annually varies from 0.28 (2013) to 0.82 (2019); there were fluctuations between 2008 and 2019, but the trend continued to rise after that. This can be the result of journal accessibility, changing research trends and study topic saturation. A smaller number of citations could make the research less visible. It may be difficult for journals with declining citation rates to draw in high-calibre submissions. To ensure that their work has the greatest possible influence and reach, researchers could choose to submit it to publications that have a larger readership.

Analysis of the contributing institution

Empirical evidence from Table 3 suggests that a number of esteemed establishments and academic institutions have a significant influence on the "Legume Research journal" With 343 affiliations, the Tamil Nadu Agricultural University is ranked first, followed by the University of Agricultural Sciences and the College of Agriculture, with 269 and 241 affiliations, respectively. This could be because of the institute's industrial contacts, financing possibilities, specialized knowledge and excellent research. There are advantages and disadvantages to the higher affiliated institutes. Positive aspects include effective research collaboration, a varied research portfolio and resource accessibility; nevertheless, negative aspects could include resource distribution, strategic focus and resource distribution. The information shows that the field of legume research is vibrant and diverse. Not only from Tamil Nadu Agriculture University or College of Agriculture only contributes to journal, but also studies from CCS Haryana Agricultural University, Punjab Agricultural University and University of Agricultural Sciences make important contributions to the journal, but research from a number of other universities also makes significant contributions. Gaining an understanding of the patterns in the creation of affiliations over time can

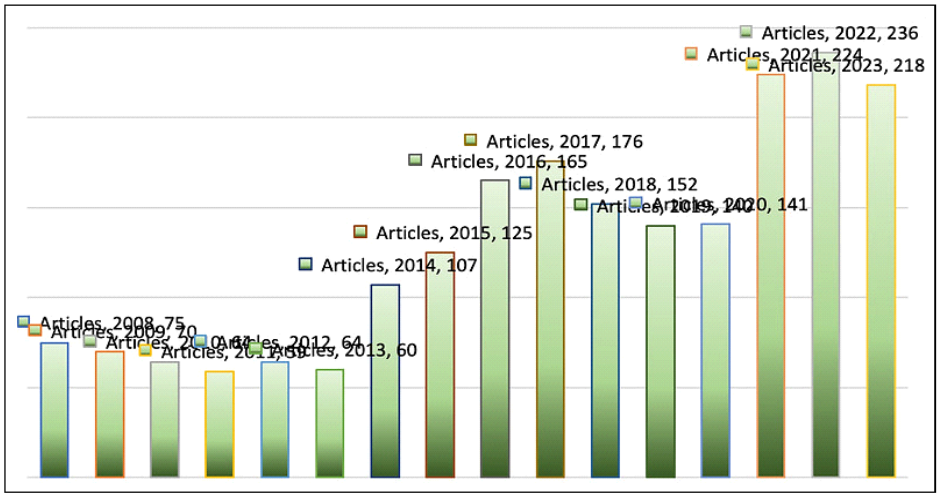


Fig 2: Annual scientific production of Legume Research.

Table 2: Average citations of Legume Research journal (2008-2023).

Year	Mean TC per article	N	Mean TC per year	Citable years
2008	3.95	75	0.25	16
2009	6.31	70	0.42	15
2010	4.34	64	0.31	14
2011	4.97	59	0.38	13
2012	4.66	64	0.39	12
2013	5.78	60	0.53	11
2014	4.65	107	0.47	10
2015	5.5	125	0.61	9
2016	5.16	165	0.64	8
2017	5.41	176	0.77	7
2018	4.88	152	0.81	6
2019	4.09	140	0.82	5
2020	2.57	141	0.64	4
2021	1.93	224	0.64	3
2022	0.81	236	0.41	2
2023	0.28	218	0.28	1

help one understand how this field's research landscape is changing, including changes in research priorities and the growth or decrease of joint efforts (Fig 3).

Authors

Most prolific authors

We have determined who the most productive and often mentioned authors in the field are by using bibliometrix services. We have also looked at how these authors' works have been distributed over time. To avoid misrepresenting writers with similar initials and surnames, author disambiguation was done manually for this section. The authors who have written the most about the subject are depicted in Fig 4. The writers with the greatest number of

Table 3: Affiliation Institutes of Legume Research journal (2008-2023).

Affiliation Institute	Articles
Tamil Nadu Agricultural University	343
University of Agricultural Sciences	269
College of Agriculture	241
Punjab Agricultural University	169
CCS Haryana Agricultural University	144
ICAR-Indian Agricultural Research Institute	94
ICAR-National Dairy Research Institute	94
Maharana Pratap University of Agriculture and Technology	82
Not reported	74
ICAR-Indian Institute of Pulses Research	73

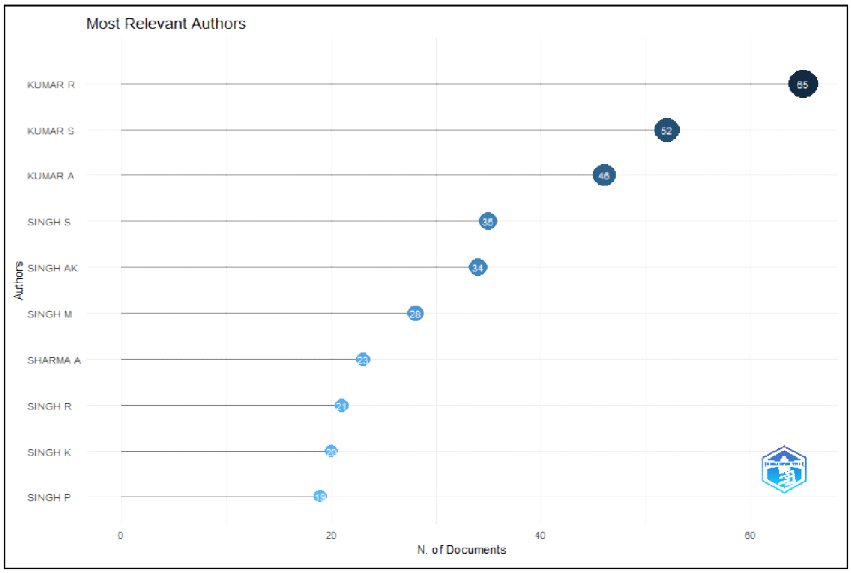


Fig 3: Affiliations production (2008 to 2023) of Legume Research.

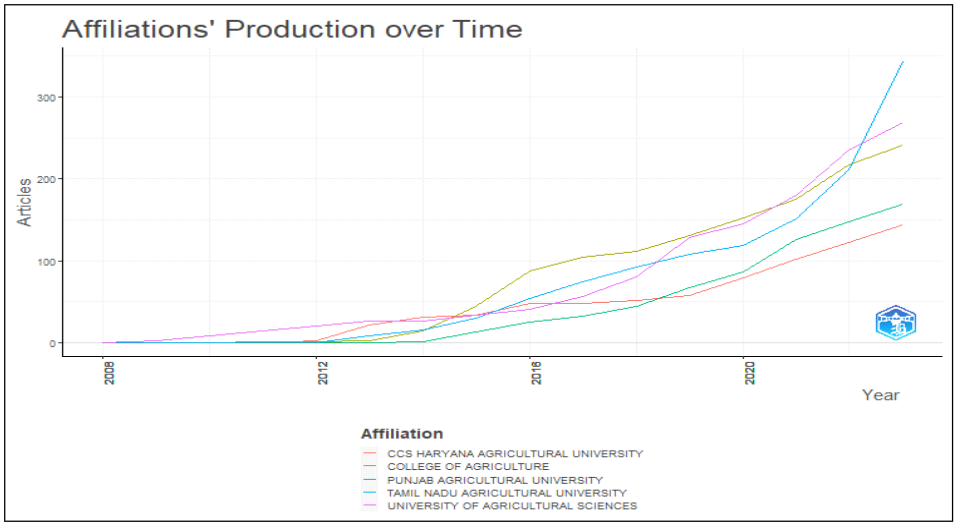


Fig 4: Most prolific authors of Legume Research.

articles in the Scopus database alone are displayed below. Rakesh Kiran Kumar, Sunil Kumar, Ajeev Kumar, Sanjay Singh and Anil Kumar Singh are the top five. Author Rakesh Kiran writes a lot and discusses topics like cultivars and pulses as most of research included this (Fig 4).

Authors production over time

The distribution of the most prolific writers' output over time is seen in Fig 5. This allows us to determine the productivity and diversity of research in different fields. It is evident from this figure that each author was still working in 2022. The authors with the longest publishing histories in this topic are Singh S, Kumar S, Singh AK and Singh R. They were the first publishers to begin publishing on the theme in 2008. In 2022, Kumar R published the most articles (11) with a total of 1.5 citations. However, the greatest citation was noted in 2020 (2.5). One bibliometric principle that gave focus on the productivity distribution of writers in a certain topic is Lotka's Law. The law, which bears Alfred Lotka's name, is especially helpful in the subject of library and information science and has been used to evaluate writers' output in academic and scientific publications. The following is a mathematical expression of the law as a power-law distribution (Lotka, 1926).

$$n_k = \frac{1}{k^2} \times n_1$$

n_k= No. of authors who have published k papers.
n_1= No. of authors who have published one paper.

The graph showing the Lotka's Law curve is shown in Fig 6. The results show that 15.4% of writers have published two papers on the topic, compared to 72.7% who have only published one. Three or more papers have been published by 5% of the sample. This highlights the few prolific writers on the topic of legumes, with the majority of writers making minimal contributions.

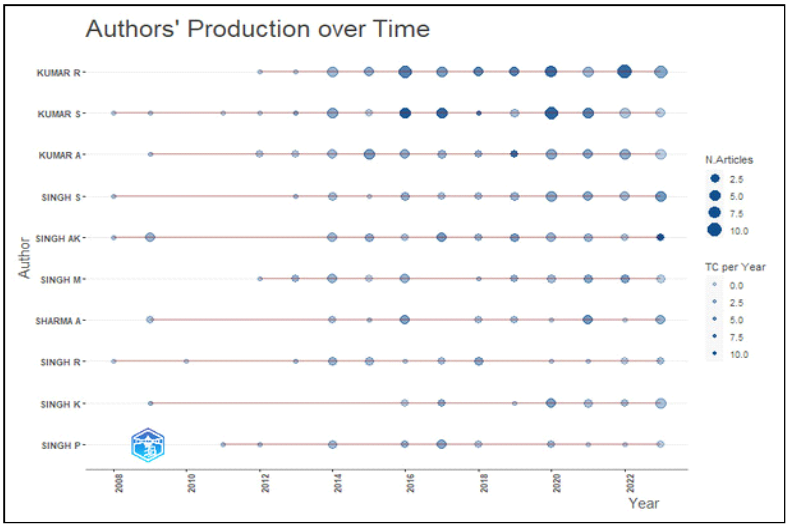


Fig 5: Authors production (2008 to 2023) of Legume Research.

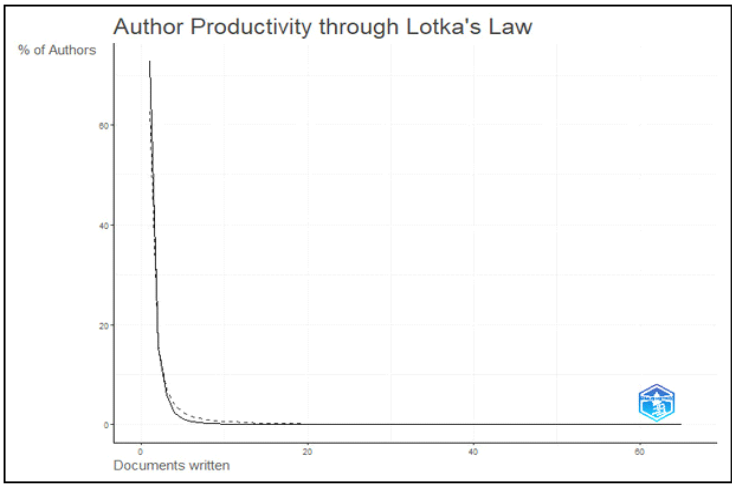


Fig 6: Authors productivity of Legume Research.

Apart from the author's impact, the value of the H index in Fig 7 illustrates the author's influence. With the greatest H index of 9, Kumar R influenced the most works on chickpea in legume research, followed by Singh AK, Kumar A, Savaliya JJ, Singh J, Jevitha DM, Kumar J, Pansuriya AG and Sharma A. When developing and discussing the significance of study results, article writers-including researchers-can greatly benefit from this information.

Most global cited documents

The list of the most referenced papers in the field of legume research is presented in Fig 8. Meena H. (41) no. of papers, "Reaction of sowing dates and bio regulators on yield of cluster bean under current climate in alley cropping system in eastern U.P., India," is ranked first among the Top 3 in total citations descending order. The paper "Proximate composition, nutritional profile and health benefits of legumes-A review" by Kamboj R (52) is ranked second. The work Dhakal Y (58), titled "Effect of INM on nodulation, yield, quality and available nutrient status in soil after harvest of green gram," is found at the end, at the third position.

Three fields plot analysis of legume research

Used a Sankey diagram as a basis for work (Fatehi *et al*., 2020). Three subject correlations can be seen by field plot analysis, as shown in Fig 9. This contains three components of the key terms for CR-Citated References, AU-Authors and DE-Authors. These three components are plotted in grey to indicate the relationship between them in a single field. The central field serves as the focal point of the three-field plot. The author, Kumar R., who has authored the most publications on "chickpea," is the most important component of Fig 9. In addition, he references works from

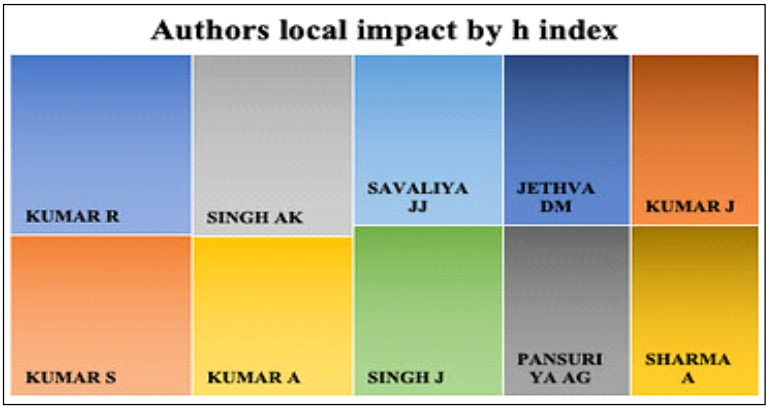


Fig 7: Authors local impact of Legume Research.

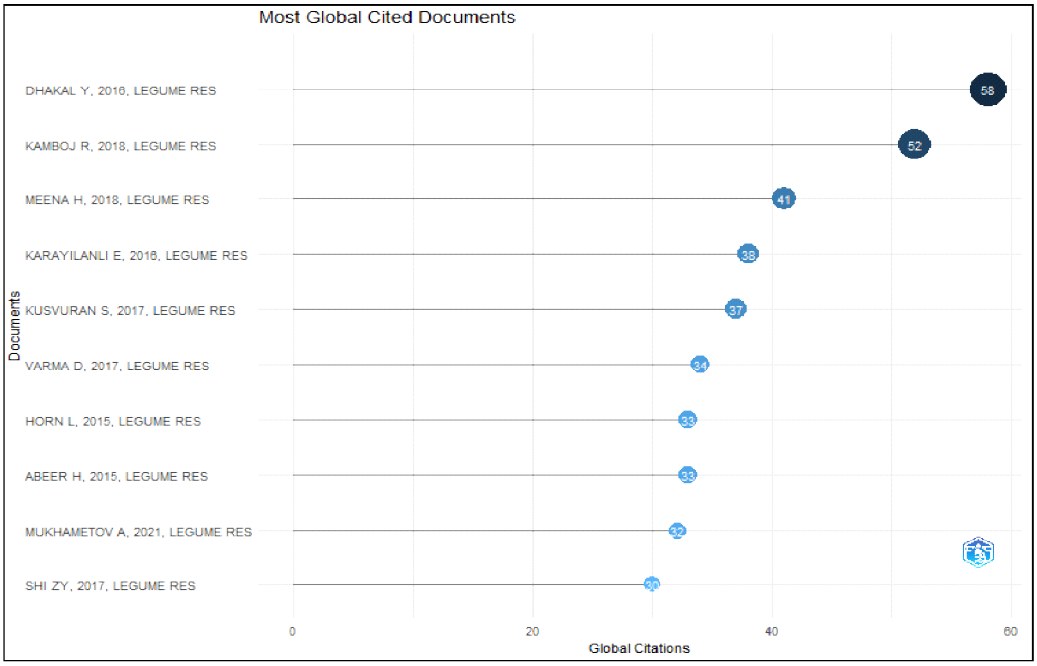


Fig 8: Most Global cited Documents of journal Legume Research.

1957 and has a history of writing chickpea-related writings. The author′s reference article in the middle field (AU), further related to the study theme (DE), is indicated by the left field, CR. The next author is Kumar S, who appears to have finished second in the chickpea study based on his shorter rectangle than Kumar R.

Following in the sequence of the names are Kumar A., Singh A.K., Singh S., Singh M., Kumar M., Singh S.K., Singh P., Singh R., Sharma P. and Singh K., Sharma R., Singh J., Sharma S., Meena R.K., Kumar V., Singh B. and Kumar N. The study's theme is relevant to each author and the sources cited in the paper are cited. On the right side of the theme, the chickpea is the most trending crop (light green), followed by the soybean, cowpea, path analysis, germination, yield, mung bean, correlation, seed yield, pigeon pea, genetic diversity, heritability, lentil, genetic variability and economics.

Word analysis

Word frequency is shown graphically by-word clouds. The size of the text in the graphic representation is based on how frequently a term appears in the material under analysis. Word clouds are useful for locating a written text's centre. Using a word cloud to assess the most common words in bibliometric studies shows that most of the research is focused on those areas. Furthermore, terms in lowercase letters suggest possible lines of inquiry. A word cloud converts texts into tags, which are words whose size and colour in the generated cloud indicate their relative worth (Mulay *et al*., 2020).

Fig 10 on the other hand, illustrates the 8 years (2008-2015) developmental trend of the most frequently utilized terms in the studies examined within this research journal. As observed, the studies featuring the terms *Cicer arietinum*, *Arachis hypogea*, *Cajanus cajan*, *Vigna mungo*, *Glycine max*, *Vigna radiata*, *Pisum sativum* and *Helicoverpa armigera* have increased since 2008. Highest frequency was observed in *Cicer arietinum.* Fig 11 shows a tree map of the 50 most common bigrams of research titles. The majority of published papers (10%) containing the word "*Cicer arietinum*" were among these research titles (52 times). *Arachis hypogea* (41 times), *Vigna mungo* and *Cajanus cajan* (8%), followed by *Glycine max* (7%), was the second most published title, whereas *Vigna radiata* was 6%.

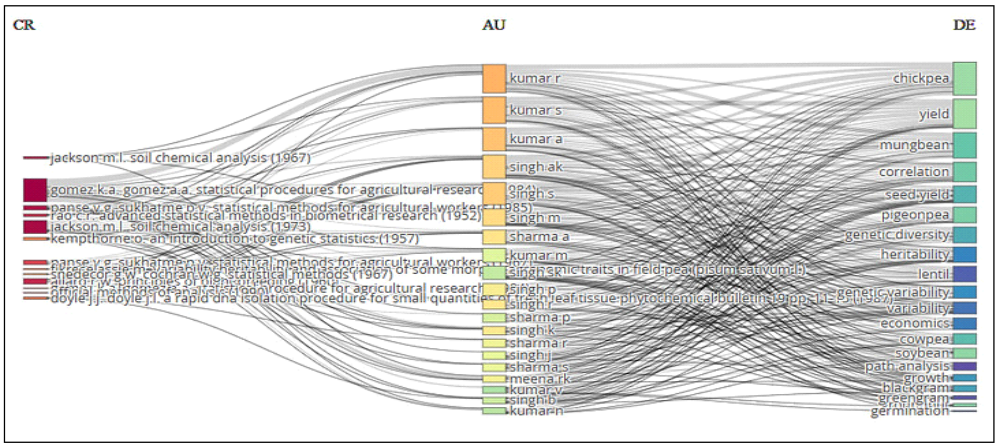


Fig 9: Three fields plot analysis of Legume Research.

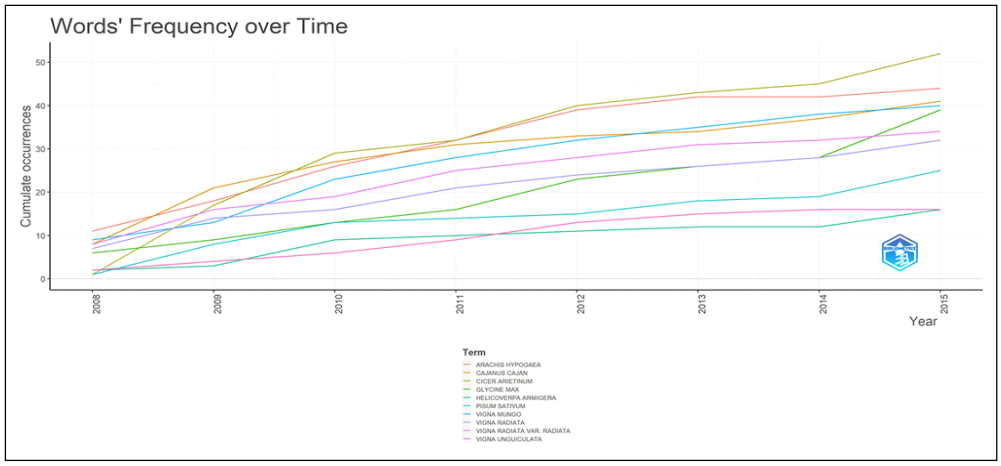


Fig 10: Words frequency (2008 to 2015) of Legume Research.

Sketching historical trajectories and exploring research frontiers through author key word co-occurrences and trend topics analysis

On the legume research journal, key word and trend topic analysis aids in examining the evolution of research hotspots, the historical development trajectory and potential future research paths. The trend topics map was created using Biblioshiny software and it was noted how the topics development correlated with the study of legumes. As per Kirtania (2023), Fig 12 displays the co-occurrence analysis.

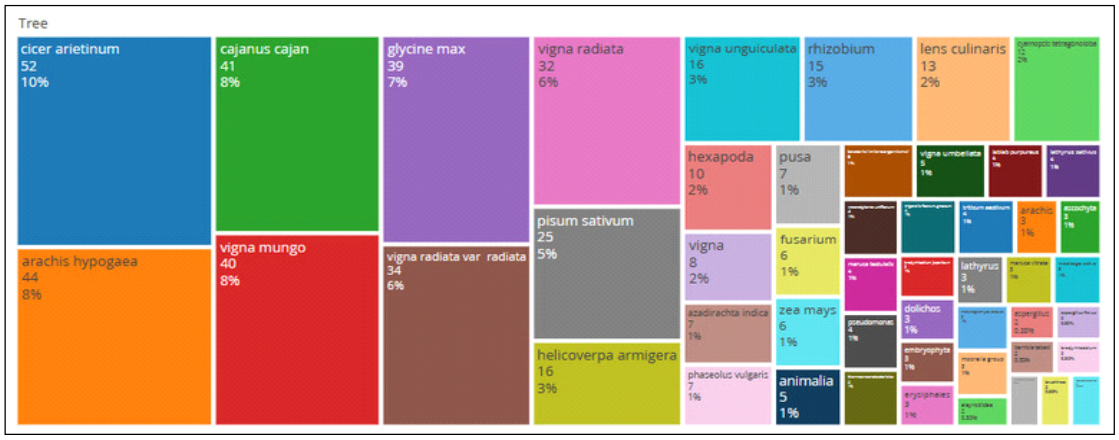


Fig 11: Tree diagram of keywords in Legume Research.

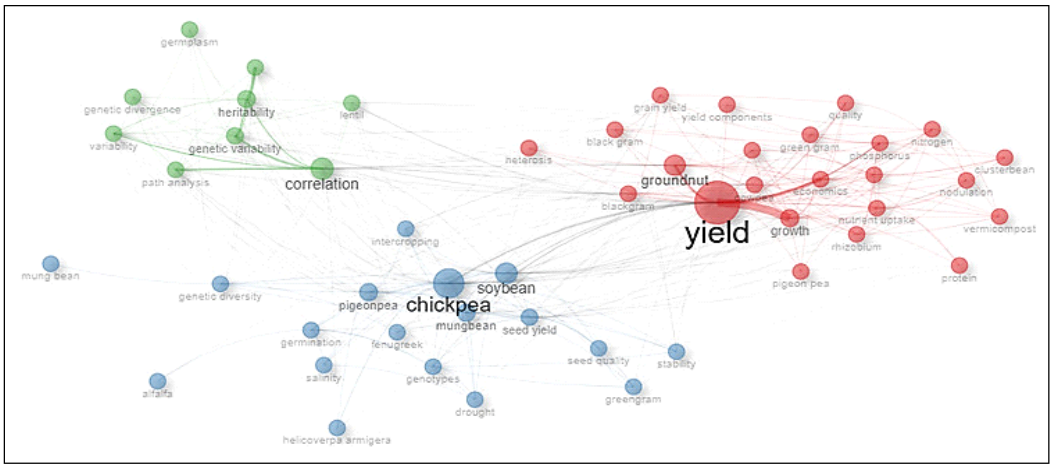


Fig 12: Keyword co-occurrences in Legume Research.

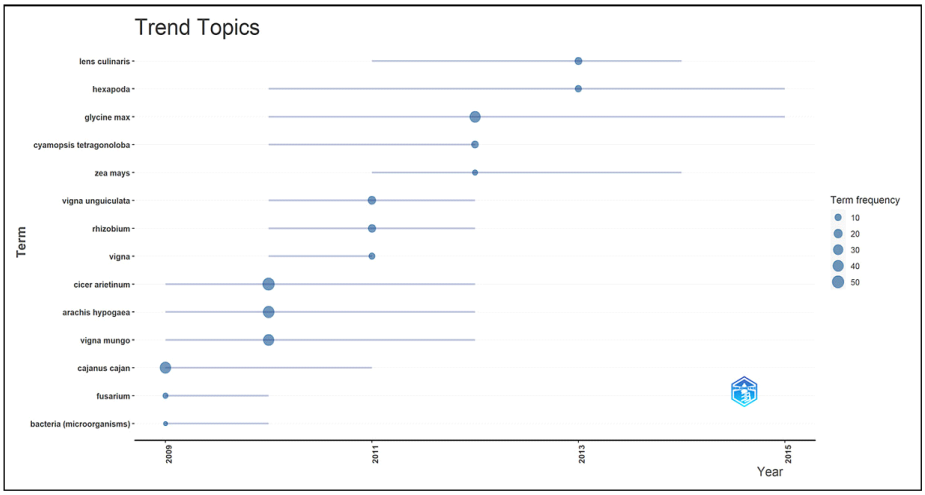


Fig 13: Trend topics of keywords in Legume Research.

An efficient method for comprehending knowledge structures and research trends is keyword co-occurrence analysis. Understanding primary and secondary publications is facilitated by this. The first step should be to identify nodes based on size in Fig 12. The line connecting two nodes indicates a connection between the two groups, whereas this indicates the quantity of documents. The examination of keywords shows that writers utilized a variety of terms in their research. A co-occurrence network of the authors' keywords is displayed in Fig 12. It is expanded with 50 items that are divided into three groups. The ball's dimensions and hue indicate the size of the cluster and its robust network. Green color represents genetic parameters, red colour represents yield parameters, and blue colour represents crops (legumes). The highest frequency among them is 232 for yield, followed by 186 and 127 for soybean and chickpea, respectively. A co-occurrence of the two keywords is shown by a link. A short line indicates a strong connection and vice versa.

Keywords are used to show how research articles evolve during time. While the majority of the publications produced between 2009 and 2011 focused on bacteria, *Fusarium*, *Cajanus cajan*, *Vigna mungo*, *Arachis hypogea*, and *Cicer aretinum*, from 2011 to 2013, the emphasis switched to keywords like *Cyamopsis tetragonoloba*, *Glycine max* and *Zea mays*. However, the most recent papers included *Lens culinaris* and Hexapoda. For instance, the topics of hexapoda and *Glycine max* persisted for a considerable amount of time, essentially from 2010 to 2016. However, the occurrence frequency of hexapoda peaked in 2013 at about 10, while that of glycine max peaked in 2012 at about 30, as shown in Fig 13.

Thematic analysis

Based on Callon's centrality and density rank, the co-occurrence network clusters from the theme mapping study were displayed as bubbles in a graph (Callon *et al.,* 1991). The size of the bubble depends on how many times

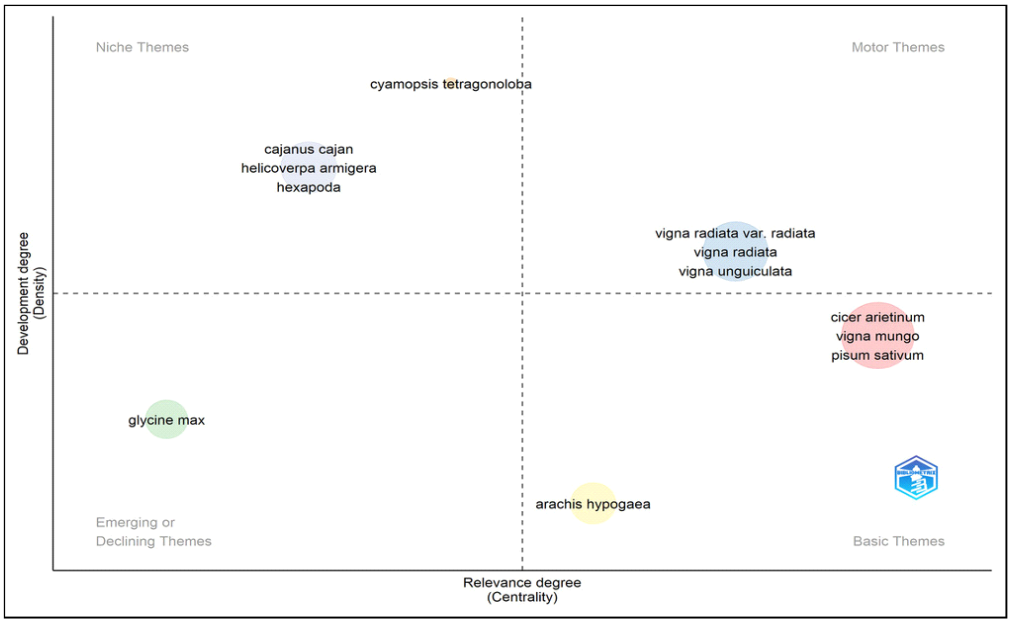


Fig 14: Thematic analysis of keywords in Legume Research.

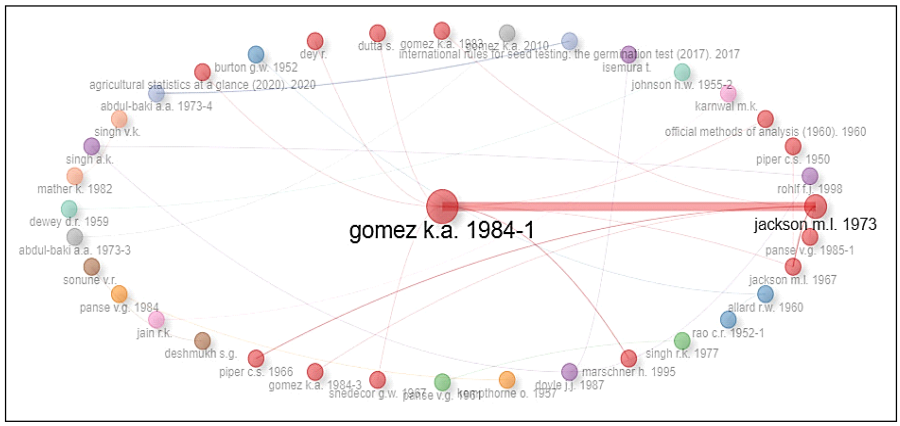


Fig 15: Co-citation network of articles in Legume Research.

a word occurs in the cluster. The X-axis indicates the importance of a specific research subject and shows network cluster centrality, or the degree of connection with other graph clusters. Density, a measure of a cluster network's internal strength and theme expansion, or development degrees, is represented by the Y-axis.

Themes graphs revealed the following findings: The motor concepts are represented by the first quadrant, upper right. Themes with high density and centrality in the cluster network are important and well-developed for organizing a study topic. Niche themes are shown in the top left quadrant of the second quadrant. Low centrality and high density suggest that themes have little bearing. The motifs in the third quadrant, on the left-bottom, are either emerging or declining. Themes that are peripheral and sparsely developed are indicated by low centrality and low density. Basic themes are shown in the bottom right quadrant of the fourth quadrant. Their modest development is suggested by their high center and low density. A few themes are essential when it comes to transdisciplinary research challenges.

The minimum cluster frequency (per thousand documents), number of labels (per cluster), and label size used by the thematic map are 250, 5, 3 and 0.3, respectively. The thematic map was created using keywords and divided into four themes, as illustrated in Fig 14. Well-developed research themes in motor themes are plotted top right and include Cluster 1: *Vigna unguiculata*, *Vigna radiata* var. *radiata*. Furthermore, the majority of academic publications on legume research share common topics. For instance, *Pisum sativum*, *Vigna mungo* and *Cicer arietinum* are all part of Cluster 1. Cluster 2 includes *Arachis hypogea*. Three clusters (upper left) illustrate niche themes: Themes like *Cajanus cajan*, *Helicoverpa armigera*, and Hexapoda are found in Cluster 1, while *Cyamopsis tetragonoloba* is found in Cluster 2. Glycine max is the only cluster found in themes that are either emerging or waning. *Vigna* group at the Motar theme and *Cicer*, *Pisum* group at the Basic theme constituted the largest cluster.

Co-citation network

Co-citation analysis is a unique method for investigating the scientific cognitive framework. Co-citation analysis is the process of monitoring pairs of papers that are cited together in the original articles. When several authors co-cite the same pairs of papers, research clusters begin to take shape. These groups of jointly referenced works usually have a same theme. Co-citation analysis literally maps the structure of specialized study areas and the entirety of science when paired with single link clustering and multidimensional scaling techniques.

It might be difficult for one person to conduct research on a particular issue by themselves; collaboration is occasionally required to finish tasks and research projects successfully. Research co-authorship is an essential part of bibliometric analysis and the level of research collaboration reveals how well the study is going at this point (Reyes-Gonzalez *et al*., 2016). By determining the co-citation linkages between authors of academic literature, one can develop and utilize an author's co-citation network to guide scientific studies (Osareh, 1996). According to Leung *et al.* (2017), the size of the bubbles indicates the total number of citations the research article has received, and the strength of the co-citation ties is shown by the thickness of the lines joining two bubbles. The bubble colour represents the cluster that the article belongs to. Five clusters are seen (1-Gomez and Gomez (1984); Jackson (1973); Panse (1985); Marschner (1995); Snedecor (1967); Piper (1966). 2- Kempthorne (1957), Panse V.G. (1984); 3- Deshmukh S.G, Sonune ; 4- Allard (1960), Rao (1952); 5- Panse (1961) in this co citation among them Gomez and Gomez (1984) and Jakson (1973) were the highest co cited authors and cluster have highest co citations with large theme (Fig 15).

Collaboration overlay with authors

Authors that have high levels of relationship or degree centrality may be regarded as important nodes in networks. They could act as effective go-betweens for different research groups or authorial communities (Husain and Mustafa, 2023). As seen in a Fig 16, there was a strong

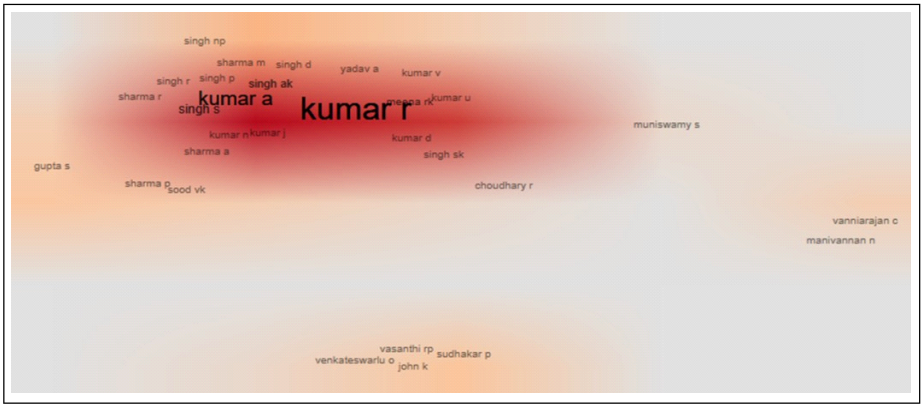


Fig 16: Collaboration overlay with authors of Legume Research.

association between Kumar R and Kumar A, who serve as links between various author groups or clusters within the network. Each author's density in the journal demonstrates their supremacy (red colour). There are five clusters in the figure and is dominated by Kumar R, Kumar A, Vasanthi P, Singh SK and Sharma A. The identification of key players, comprehension of research dynamics, mapping of research communities, assessment of interdisciplinary research, tracking of the evolution of scientific trends, facilitation of collaboration opportunities, support fordecision-making, validation and evaluation are among the significant benefits of analysing collaboration networks of authors (Fig 16).

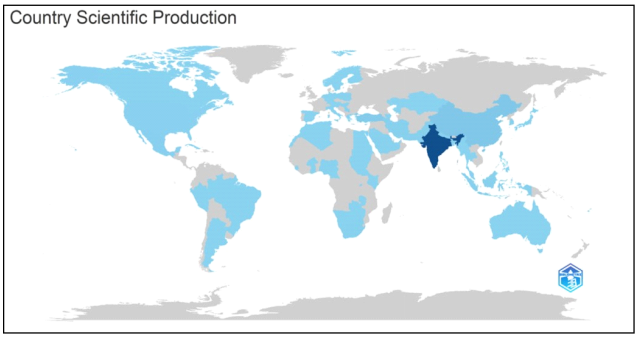


Fig 17: Countries production of Legume Research.

Social structure

It includes countries production, countries production over time, countries with corresponding author, countries and their collaboration and most cited countries (Aria, 2017).

Countries production and production over time

The study data analysis's findings provide a comparative analysis of scientific output across nations. It is evident from the colour tones that nations like Iran and Indonesia were in fourth and fifth in world followed by second and third rank with China (535) and Turkey (318) respectively, behind India (6,414). The more articles originate from a given area or nation, the darker the blue in the graphic. The following graphic displays the findings of studies pertaining to nation output (Fig 17). But by doing trend year wise analysis will give exact information of the journal (Fig 18). For all the countries it was in the incremental trend only. The top countries India, China and Turkey from the year 2008 to 2023 was 215-6414, 0-535, 0-318 publications respectively. China started first publication in 2012 whereas Turkey started first publication in 2014.

Countries with corresponding author

Using Single Country Publications (SCP) and Multiple Country Publications (MCP), Fig 19 provides more bibliometric evidence. In terms of SCP, Iran, Saudi Arabia,

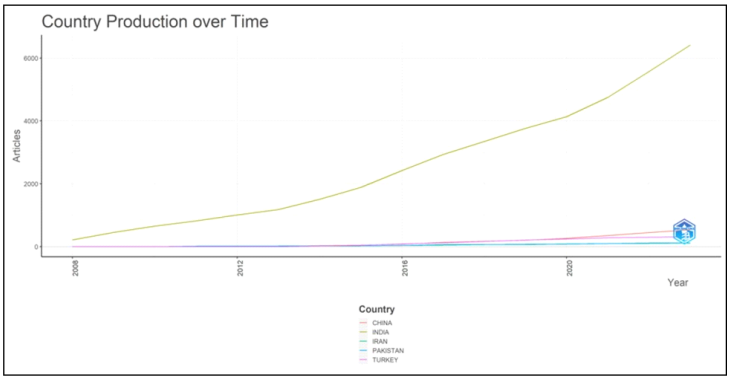


Fig 18: Countries production (2008 to 2023) of Legume Research.



Fig 19: Countries with corresponding author of Legume Research.

China, Turkey and India rank first through fifth. The top three nations in terms of MCP are Saudi Arabia, China and India. As opposed to this, China, Saudi Arabia and India rank first through third in MCP. The number of co-authored publications that come from a single nation is known as Single Country Publications, or SCP for short. On the other hand, publications that come from worldwide co-authoring are referred to as Multiple Country Publications (MCPs) (Aria, 2017).

Countries and their collaboration

According to Chen *et al*. (2020), scholarly collaboration among diverse nations or regions can play a pivotal role in advancing information dissemination and academic exchange. The collaborative global map illustrates the authors′ national affiliations, with colors denoting the strength of the relationship (weak relationships are indicated by light colors, strong relationships by dark colors, and no connection is indicated by gray). Understanding a nation′s ability and investigating variations in capacity among other nations can be accomplished with the aid of an examination of the country/region-based research distribution.

The number of papers published between 2008 and 2023 is shown by the map's blue color intensity. The partnerships that each author has with other authors in various nations are shown by the pink line. Fig 20 illustrates the global collaboration map, which shows many related countries, such as Bangladesh to Malaysia, Egypt to Germany, India to Australia, India to Myanmar, Nepal, USA and so on. Strong cooperation was seen between Bangladesh and Malaysia (frequency @12), Saudi Arabia and Egypt (frequency @5) came in second and India and Saudi Arabia and the United States came in third.

Most cited countries

The country′s dominance in article publication increases with the number of citations. A graph (Fig 21) of the writers most often cited 49 countries of origin is shown in Fig. The three nations with the highest number of citations were China (275 citations) with 2.80 citations, Turkey (508 citations) with 4.70 average citations and highest India (3783 citations) with 3 average article citations. These results demonstrated these nations' strong emphasis on researching legumes. Saudi Arabia and Iran came in second and third, with 141 and 87 citations, respectively.

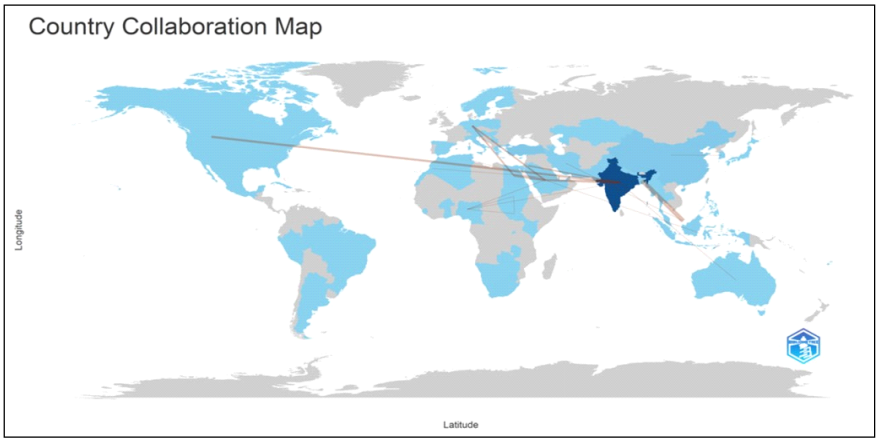


Fig 20: Countries collaboration map of Legume Research.

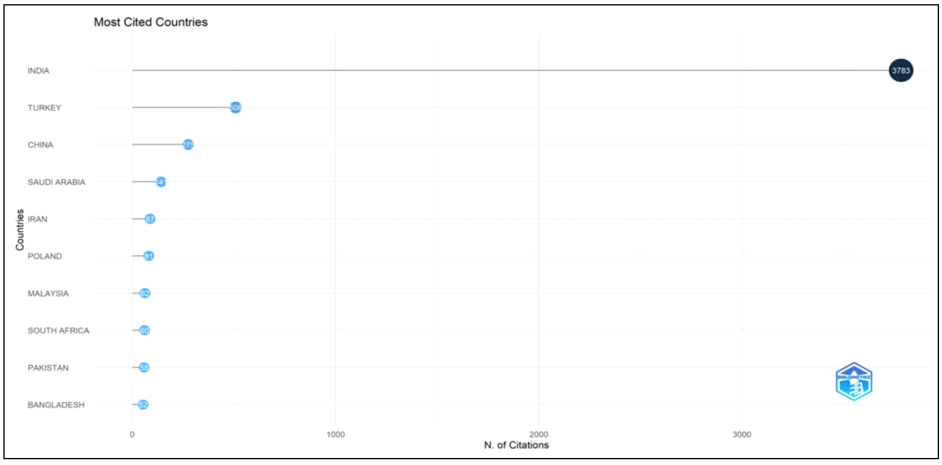


Fig 21: Most cited countries of Legume Research.

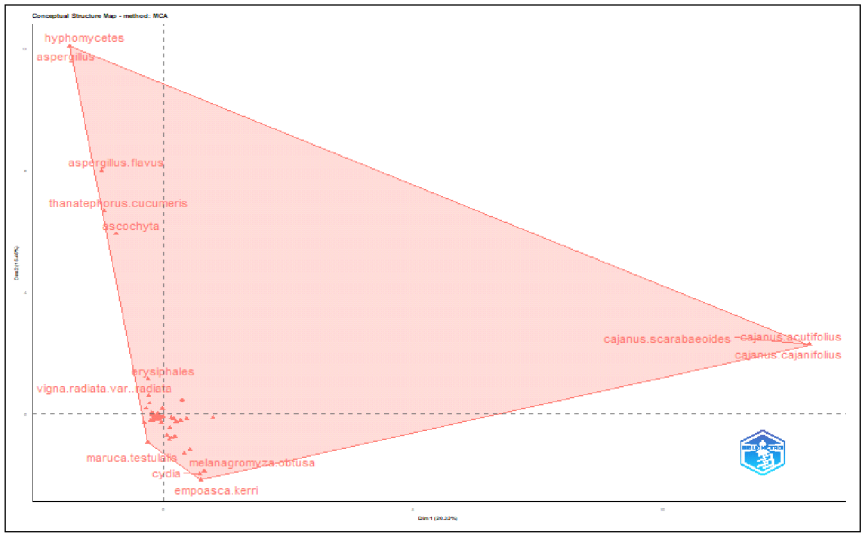


Fig 22: Factorial analysis of Legume Research.

Factorial analysis

Displays a two-dimensional graph made from the cited papers Keywords Plus theme terms. Big data with multiple variables can be summarized using a multiple correspondence analysis in a low-dimensional space, producing a two-dimensional map where words near the group's center have attracted a lot of attention recently, while words near the group's edge represent subjects that have either received less attention recently or have been combined with other topics (Xie *et al*., 2020). From the Fig 22. We can conclude that *Vigna radiata*. Var. radiata, *Cajanus cajan*, *Helicoverpa armigera*, *Melanogromyza obtusa* are there in one dimension and attracted many researchers to work on these. The others *Aspergillus flavus*, Ascochyta are in the second dimension and their importance was gained after years.

In tune with bibliometric analysis for today's agriculture system, technologies like Artificial Intelligence and Robotics *etc*. for big data management is vital (Bharvey and Sharma, 2023), similarly, the computational approach for next generation sequencing data analysis and its role in agriculture for crop improvement is also important (Begum and Banerjee, 2021).

CONCLUSION

The bibliometric analysis of the journal legume research concludes that the journal has total of 236 publications with 0.81 mean total citations per article. Tamil Nadu Agricultural University stood first among the contributing institutions with 343 articles and increasing trend of publications upto 2023.Kumar R was the highly productive author with h index of 9, published highest no. of articles (11) during the year 2022 with citation score of 1.5. Trend topics have been changed from 2008 to 2023, started with bacteria in 2008 continuing with hexapoda and *lens culinaris*. The mostly used word in legume research *Cicer arietinum*, *Arachis hypogea* and *Cajanus cajan* occurred 52 times with 10% of the documents as we seen in the tree diagram and it was in increasing trend from 2008 to 2015. There are four key themes in the majority of scholarly productions on legume research were emerging or declining themes only one cluster is present that is *Glycine max*. The largest cluster was *Vigna* group @ Motor theme and *Cicer*, *Pisum* group @ Basic theme and in niche theme *Cajanus cajan* were included. In Co-citation network, five clusters are seen in this co citation among them Gomez KA(1984) and Jakson ML (1973) were the highest co cited authors and cluster have highest co citations with large theme. Collaboration overlay with authors concluded that There are five clusters in the figure and is dominated by Kumar R., Kumar A., Vasanthi P., Singh S.K. and Sharma A.A. from Scientific production it's clear that India publications was high and the trend was increasing from 2008 to 2023 from 215-6414, followed by China and Turkey. The top five countries in terms of SCP are India, Turkey, China, Iran, and Saudi Arabia. Regarding MCP, the top three countries are China, India and Saudi Arabia. In the world collaboration map many connected countries was observed *i.e.*, Bangladesh to Malaysia, Egypt to Germany, India to Australia, India to Myanmar, Nepal, USA *etc*. Strong collaboration was in between Bangladesh to Malaysia with Frequency @12. India has highest (3783 citations) with an average citation of 3 per article followed by Turkey (508 citations). Factorial analysis gave a 2-dimension analysis of *legume research* among which *Vigna radiata* and *Cajanus cajan* was the centre and highly attracted for research.

The bibliometric examination of research on legumes point to an increase in interest in research on legumes over time, which is consistent with the understanding of the significance of legumes for environmental preservation, nutrition and sustainable agriculture. Future studies on legumes should focus on filling in the gaps that have been

found, adopting multidisciplinary strategies and tackling new issues like how climate change affects the production of legumes. The knowledge gathered from this bibliometric analysis offers a strong basis for developing the field of legume research and supporting environmental preservation, food security and sustainable agriculture.

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Ethics and conflict of interest

Since no biology (human or animal) was used, the authors declare no ethical issues. The authors state that there are no conflicts of interest with the government, business sector, or any individual in the areas of academia, labour, or intellectual property.

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