

Scientometric Insights into Research Contributions of Govind Ballabh Pant University of Agriculture and Technology

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ABSTRACT

This paper aims to evaluate the research productivity and scholarly impact of the Govind Ballabh Pant University of Agriculture and Technology through scientometric assessments. The data for this study was collected from the Scopus database, an internationally recognized platform for indexing and citation analysis, covering the period from 2001 to 2021. A total of 4,897 publications, which received 53,059 citations during this timeframe were analyzed. The study employed various scientometric techniques to conduct an in-depth examination. To ascertain the growth patterns, indices such as Annual Growth Rate (AGR), Relative Growth Rate (RGR), and Doubling Time (DT) were incorporated. Additional scientometric indicators were also evaluated to derive significant conclusions, including the Degree of Collaboration, Collaboration Coefficient, most cited publications, most prolific authors, co-authorship analysis, and keyword occurrence analysis. The findings indicate a fluctuating yet gradual increase in the institution's research activities. The most prolific author is Kumar, A., who has contributed 165 publications. The period between 2017 and 2021 was identified as the most productive research output.

KEYWORDS: Govind Ballabh Pant, Agriculture Research, Scientometrics, Collaboration Coefficient, Visualization.

1. INTRODUCTION

Scientometrics is the quantitative study of science, scientific communication, and policy, using statistical and mathematical techniques to analyze scientific processes (Hess, 1977). It covers various aspects such as research trends, authorship, collaboration, citation studies, and author productivity. Scientometric methods, including co-

authorship networks, citation mapping, and bibliographic coupling, help identify emerging research areas and evaluate research performance. These methods are essential for literature reviews and detecting new research trends (Brindha and Murugesapandian, 2016).

In higher education, research performance is a key factor in assessing academic success, particularly for accreditation bodies like UGC, AICTE, and NBA. These bodies use research productivity to evaluate institutions and identify performance gaps (Pradhan et al., 2020). In India, the importance of research productivity in agriculture has grown, with institutions like GBPUAT playing a vital role. This study applies scientometric indicators to assess the research productivity of GBPUAT, Pantnagar, from 2001 to 2021. Using data from the Scopus database, the study evaluates publication output, growth rate, paper quality, global ranking, collaboration patterns, and citation impact. The findings are based on both qualitative and quantitative analyses, highlighting the university's research performance.

2. REVIEW OF LITERATURE

This literature review aims to overview key concepts, factors, and measures related to research productivity. There is a large body of knowledge about scientometric research analysis. A few such studies are as follows:

Singh et al. (2021) analyzed the research productivity of Forest institutions published between 1990 and 2019. They discovered that multi-authored papers account for a higher percentage of all publications than single-authored papers. Only 91 publications out of 893 were written by single authors (10.2 %), demonstrating the institute's collaborative research policy. Rawat et al. (2021) reviewed the Wadia Institute of Himalayan Geological (WIHG) research performance from 1991 to 2020. According to the findings, the most extensive documents (7.21%) were published in 2017. The countries that provided the most documents were India (1289) and the USA(97). Parida et al. (2020) employed scientometric metrics to examine the research contributions of the Indian Institute of Medical Sciences (AIIMS), Bhubaneswar. They identified that the scientist R. R. Das was found to be the most productive author, with 46.43 % of the average growth rate. Chakravarty and Madaan (2016) conducted a Scopus-reflected study of seven research and higher education institutions in Chandigarh City, India, to identify the growth of scholarly publications and patents for around six decades. The authors concluded that the seven institutes produced research papers on twenty subjects. The Post Graduate Institute of Medical Education and Research has produced more research papers, followed by the Panjab University. Deepika Lakshman (2017) conducted a study to determine the research productivity of the 58 government and 164 aided Arts and Science colleges in Kerala from 1989 to 2015. The study population published a total of 1969 articles, with more articles on chemistry, materials science, physics, and spectroscopy. The number of articles from arts and humanities was significantly less. The aided colleges were found to be more productive compared to government colleges. Chauhan and Preethi Mahajan (2017) measured the quality and quantity of Indian Library and Information Science research output from 1951 to 2010, extracting data from the Science Citation Index (SCI). The study also covered the volume of PhDs in library and information science. Information centres contributed 6% of total LIS research output, whereas LIS professionals working in technical institutions made the highest contribution (34%). The authors identified the low productivity and quality of research output in library and information science in India. Asnafi (2017) intended to survey the participation of the Iranian Library and Information Science departments in ResearchGate as an academic social network. Iranian Library and Information Research faculty members analyzed the members, RG Score, Impact

Points, Publications, Citations and Reads. Kuo, Tsai, Wu, and Alhalabi (2017) presented an empirical survey of the top 150 researchers' grants and their RG scores among 126 colleges of management in Taiwan and also found that a strong correlation between the research grants and RG scores based on the analysis of college as a whole. However, the relationship becomes insignificant for individual researchers. Elsayed (2016) investigated Arab researchers' attitudes and perceptions toward the use of academic, social networks (ASNs), with a sharp topical focus on the ResearchGate (RG) network. From six Arab universities, a sample of 2,991 Arab researchers was invited to participate by online questions and 315 participants filled out the questionnaire. The study revealed that three-quarters of the respondents use ASNs to share publications, and most researchers subscribed to more than one ASN, but RG was the most frequently used one.

3. OBJECTIVES OF THE STUDY

This scientometric study examines GBPUAT's publications indexed in Scopus from 2001–2021, focusing on:

- ✓ Publication trends and growth metrics (AGR, RGR, DT).
- ✓ Authorship patterns and collaboration indices (DC, CC).
- ✓ Frequently cited publications.
- ✓ Institutional and international collaborations.
- ✓ Key funding agencies in agricultural research.

4. RESEARCH METHODOLOGY

This study uses scientometric indicators to check the research productivity of GBP University of Agriculture and Technology Pantnagar. The paper depicts the findings of the scientometric study application on the research productivity published from 2001 to 2021. The Scopus database, an internationally recognized indexing and citation analysis database from Elsevier, was utilized to retrieve the data for the given period. The evaluation is based on a variety of criteria and scientometric factors. The analysis and visualization are carried out using a variety of qualitative and quantitative measurements. The study's findings and conclusions are based on overall publication output, growth rate, paper quality, global ranking, collaborative work exchanged at geographical levels, citation impacts, etc.

5. SCOPE AND LIMITATIONS

This study focuses on GBPUAT's research output over 21 years, examining publications, patents, and collaborations. It analyzes quantitative and qualitative facets while acknowledging limitations like data availability, temporal constraints, and external influences. Metrics like bibliometric indicators are used, but field-specific variations and external factors like funding changes are considered. Findings are specific to GBPUAT and serve as a foundation for future strategic planning and enhancing research excellence.

By offering a detailed scientometric analysis, the study aims to evaluate GBPUAT's research contributions, impact, and collaborative patterns, providing actionable insights to strengthen its research culture and multidisciplinary efforts.

5.1. Selection of the Database

A scientometric analysis of GBPUAT's research productivity from 2001 to 2021 was conducted using the Scopus database. Scopus was chosen for its extensive coverage of scholarly papers across various fields, including scientific articles, conference papers, and book chapters. Its comprehensive indexing of journals, conference proceedings, and publications from top publishers made it an ideal platform for assessing the university's research output. The analysis incorporated both domestic and international publications, offering a thorough examination of GBPUAT's scientific contributions.

5.2. Search Strategies

The Affiliation Search, "Govind Ballabh Pant University of Agriculture and Technology", was conducted. The search string used for the study: (AF-ID ("Govind Ballabh Pant University of Agriculture and Technology" 60012351) AND (LIMIT-TO (PUBYEAR,2021) OR LIMIT-TO (PUBYEAR,2020) OR LIMIT-TO (PUBYEAR,2019) OR LIMIT-TO (PUBYEAR,2018) OR LIMIT-TO (PUBYEAR,2017) OR LIMIT-TO (PUBYEAR,2016) OR LIMIT-TO (PUBYEAR,2015) OR LIMIT-TO (PUBYEAR,2014) OR LIMIT-TO (PUBYEAR,2013) OR LIMIT-TO (PUBYEAR,2012) OR LIMIT-TO (PUBYEAR,2011) OR LIMIT-TO (PUBYEAR,2010) OR LIMIT-TO (PUBYEAR,2009) OR LIMIT-TO (PUBYEAR,2008) OR LIMIT-TO (PUBYEAR,2007) OR LIMIT-TO (PUBYEAR,2006) OR LIMIT-TO (PUBYEAR,2005) OR LIMIT-TO (PUBYEAR,2004) OR LIMIT-TO (PUBYEAR,2003) OR LIMIT-TO (PUBYEAR,2002) OR LIMIT-TO (PUBYEAR,2001))). A total of 4,897 data was collected from the Scopus database on February 23, 2023.

The research analyzed growth metrics, author productivity, collaboration, co-authorship networks, subject distribution, and other scientometric indicators. Growth measures were assessed using Annual Growth Rate (AGR), Relative Growth Rate (RGR), and Doubling Time (Dt). Author productivity was examined, along with collaboration indicators like Degree Centrality (DC) and Closeness Centrality (CC). A global co-authorship network analysis identified trends in international collaborations and key research partners. Subject-wise publication distribution highlighted GBPUAT's research strengths across disciplines. Co-authorship analysis pinpointed prolific authors and their collaboration networks, revealing productive partnerships. The study also explored funding agencies and identified frequently cited documents to evaluate the impact of GBPUAT's research. VOSviewer software (version 1.6.16) was used to visualize and present the results effectively.

6. DATA ANALYSIS

The primary goal of data analysis is to transform raw data into actionable insights to create a competitive advantage, solve complicated challenges, and drive continuous development. Organizations may optimize operations, improve customer experiences, and develop well-informed predictions and forecasts using data analysis. Data analysis techniques and approaches include descriptive, exploratory, inferential, predictive, and prescriptive analyses. Descriptive analysis entails summarizing and visualizing data to comprehend its fundamental properties, such as central tendency, dispersion, and distribution. Exploratory analysis seeks to find links, trends, and outliers in data to produce ideas and guide future research. Based on a sample of data, inferential analysis uses statistical tools to make inferences and draw conclusions about a wider population. Predictive analysis uses statistical and machine learning

methods to make forecasts based on historical data. Finally, prescriptive analysis generates recommendations and ideal solutions based on predefined restrictions and objectives.

6.1. Yearly Publication Trends of GBPUAT

Figure 1 depicts a detailed analysis of the distribution of publications with citations for 21 years from 2001 to 2021. This study evaluated a total of 4,897 documents. On average, 233.2 papers were published yearly, demonstrating a constant flow of research over time. Furthermore, the average number of citations per year was 2,526.6, explaining the significance and influence of the published works. Most documents, 401, were published in 2021, showing a significant production of research in the most recent year examined. In contrast, the lowest number of documents, 113, was seen in 2001, indicating a comparably lower level of research effort at the start of the analyzed period. When the distribution of publications within specific time frames was examined, it was discovered that 32.38% of all documents (1,586 articles) were published in the last five years, precisely between 2017 and 2021. This suggests a massive increase in research activities in the previous few years. Furthermore, 60.44% of the materials (2,960 papers) were published within the last ten years, from 2012 to 2021. This timeline encompasses much of the research output and shows the studies conducted throughout the previous decade's continuous relevance and influence.

In comparison, a lesser number of the documents, 14.64% (717 papers), were published in the first five years of the study period, from 2001 to 2005. This indicates a smaller volume of research throughout the early years. Similarly, 34% (1,665 papers) of the documents were published within the first ten years, from 2001 to 2010. This chronology sheds light on the early phases of research output, suggesting a consistent publication growth during this period. Overall, this analysis of the year-by-year distribution of papers with citations indicates patterns in research production over 21 years, highlighting both the current boom in publications and the long-term growth of research. The study's findings show an unpredictable growth pattern in the number of documents analyzed. A total of 4,897 papers were reviewed, and these papers garnered a total of 53,059 citations. Each publication, on average, garnered 10.84 citations (ACPP) (Figure 2), demonstrating a high effect and recognition within the academic world.

The maximum number of citations, 4038, was reported in 2020. This increase in citations indicates a particularly significant year in terms of the influence and visibility of published works. It suggests that the research conducted during this particular year struck a chord with other researchers and drew significant attention and acknowledgment. There were continual swings in research production and citations during the study period. This means that the quantity of published papers and citations fluctuated throughout time. Despite these oscillations, an overall upward trend was identified, indicating a good trajectory for research output and scholarly recognition. It also shows that 53,059 citations were received among the 4,897 publications evaluated, averaging 10.84 citations per paper. The year with the most citations was 2020, signifying a particularly significant year. The constant changes throughout the study period and a growing research production and citation tendency indicate a dynamic and evolving academic scene.

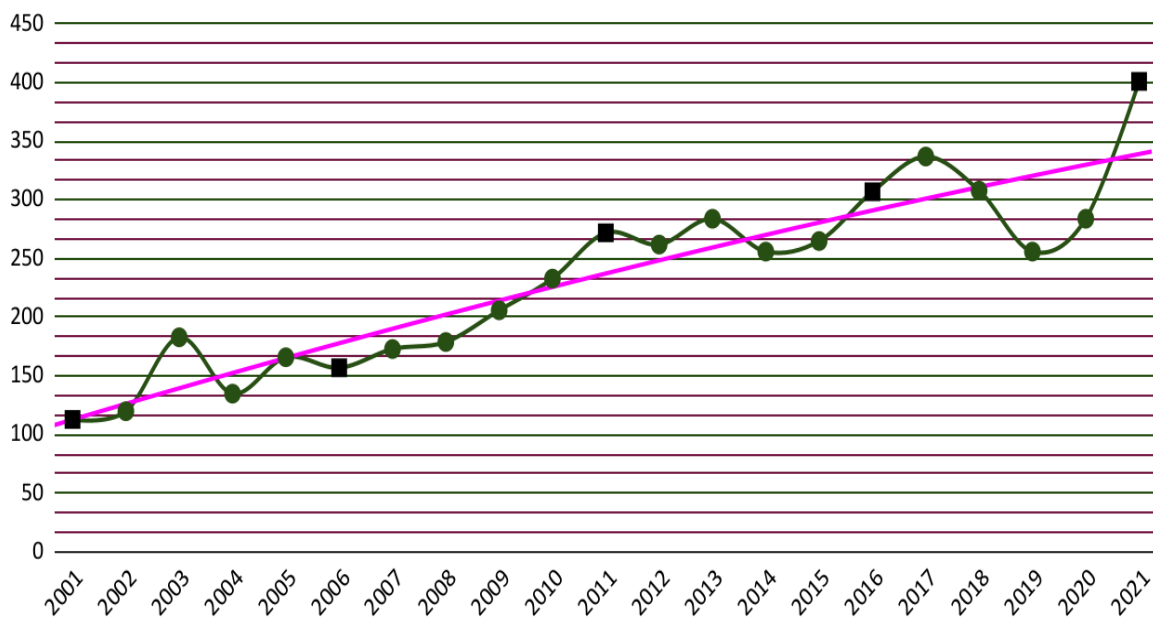


Fig 1: Year-wise productivity trends

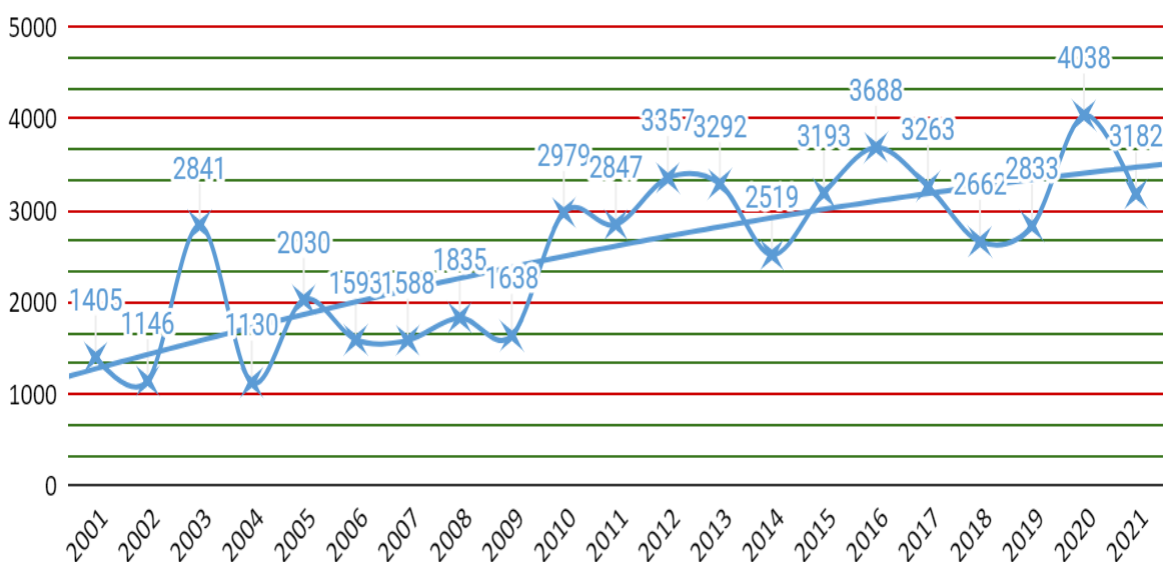


Fig 2: Year-wise Citation Patterns

6.2. Publication Growth Rates

6.2.1. Annual Growth Rate (AGR)

The annual growth rate (AGR) of publications from 'Govind Ballabh Pant University of Agriculture and Technology' throughout the study period is shown in Table 1. The AGR is a metric that reflects the rate at which the number of university publications has changed over time. The highest AGR was recorded in 2003 when it reached 52.50. This indicates a significant increase in university publications during that year, showing a considerable growth rate. Following closely behind, 2021 displayed an AGR of 41.20, indicating another significant rise in research production. On the other hand, the lowest AGR of -26.23 was recorded in 2004. A negative AGR suggests

a decrease in publications relative to the previous year, indicating a decline in research output. The formula for calculating the annual growth rate (AGR) is as follows:

$$AGR = \frac{\text{End value} - \text{First value}}{\text{First value}} \times 100$$

6.2.2. Relative Growth Rate (RGR)

The RGR concept, first developed by Hunt in 1990, measures the increase in size per unit of measurement. The RGR allows us to quantify a particular entity's growth over time. For calculating the mean relative growth rate (RGR) over the specific period of the interval, the formula:

$$RGR = (1 - 2^r) = \frac{\text{Ln}(W2) - \text{Ln}(W1)}{T2 - T1} \times 100$$

Table 1 presents the Relative Growth Rate (RGR) for the entity during the study period. The highest RGR of 0.34 occurred in 2021, indicating significant growth, while the lowest RGR of -0.30 was recorded in 2004, reflecting a decline. The average RGR for the entire period was 0.06, providing an overall measure of growth. This data allows for an evaluation of the entity's growth patterns, highlighting fluctuations between periods of significant increase and decline.

6.2.3. Doubling Time (Dt)

The concept of Doubling Time (Dt) relates to the time it takes for a quantity to double in size or value. It is a valuable indicator for determining a given entity's growth or expansion. The researchers applied this formula to know the doubling time:

$$Dt = \frac{0.693}{RGR}$$

The average doubling time was discovered to be 2.86 throughout the investigation. However, the particular values of the doubling time fluctuated significantly, ranging from -18.50 in 2012 to 20.06 in 2015. These variances reflect significant differences in the rate at which the quantity being analyzed doubled in size or value across different years of the study.

Table 1: Yearly Growth Rates and Doubling Time

Year	AGR	RGR	Dt
2001	-	-	-
2002	6.19	0.06	11.53
2003	52.5	0.42	1.64
2004	-26.23	-0.3	-2.28
2005	22.96	0.21	3.35
2006	-5.42	-0.06	-12.43

2007	10.19	0.1	7.14
2008	3.47	0.03	20.33
2009	15.08	0.14	4.93
2010	13.11	0.12	5.63
2011	16.74	0.15	4.48
2012	-3.68	-0.04	-18.5
2013	8.4	0.08	8.59
2014	-9.86	-0.1	-6.68
2015	3.52	0.03	20.06
2016	15.85	0.15	4.71
2017	9.77	0.09	7.43
2018	-8.61	-0.09	-7.7
2019	-16.88	-0.18	-3.75
2020	10.94	0.1	6.68
2021	41.2	0.34	2.01
Total	7.58	0.06	2.86

6.3. Collaboration Measures

6.3.1. Degree of Collaboration

The degree of collaboration (DC) is counted by the formula that Subramanyam, 1983 suggests. The degree of collaboration is expressed as:

$$DC = \frac{Nm}{Nm + Ns}$$

DC = degree of collaboration; Nm = Number of multi-authored papers; Ns = number of single-authored papers.

The number of collaborative research papers to the total number of research papers in the discipline during a specific period is measured and varied from 0.70 to 0.76 (Table 2) in different years with an average (mean) degree of collaboration of 0.74.

6.3.2. Collaboration Coefficient

The collaboration coefficient (CC) is counted by the formula suggested by Ajiferuke et al., 1988. The formula is as given below:

$$CC = 1 - \frac{\sum_{j=1}^A \frac{1}{j} (f_j)}{N}$$

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Where j = The number of authors in an article, i.e., 1, 2, 3; f_j = The number of j authored articles; N = The total number of articles published in a year, and A = The total number of authors per paper.

The researchers have measured from the study of Govind Ballabh Pant University of Agriculture and Technology and found that the minimum collaboration coefficient was 0.49 in 2001, 2006 and 2011, while the maximum was 0.54 in 2005 and 2019. The average Collaborative Coefficient is 0.51. The study clearly shows that the coefficient of cooperation is less than 0.6. It indicates that Govind Ballabh Pant University of Agriculture and Technology research collaboration is average.

Table 2: Collaborative measures

Year	N1	N2	N3	N4	N5+	Ns+Nm	Nm	DC	CC
2001	113	113	90	55	103	474	361	0.76	0.49
2002	120	118	94	73	138	543	423	0.78	0.47
2003	183	171	117	79	104	654	471	0.72	0.53
2004	135	134	104	65	87	525	390	0.74	0.51
2005	166	154	102	57	98	577	411	0.71	0.54
2006	157	156	108	77	160	658	501	0.76	0.49
2007	173	166	117	77	157	690	517	0.75	0.5
2008	179	169	109	62	68	587	408	0.7	0.56
2009	206	203	165	115	142	831	625	0.75	0.5
2010	233	228	164	111	140	876	643	0.73	0.52
2011	272	260	197	137	270	1136	864	0.76	0.49
2012	262	258	204	131	197	1052	790	0.75	0.5
2013	284	279	206	127	228	1124	840	0.75	0.51
2014	256	253	185	113	196	1003	747	0.74	0.51
2015	265	261	207	135	227	1095	830	0.76	0.5
2016	307	297	224	131	200	1159	852	0.74	0.52
2017	337	334	232	133	171	1207	870	0.72	0.54
2018	308	297	228	144	237	1214	906	0.75	0.51
2019	256	243	161	104	142	906	650	0.72	0.54
2020	284	272	213	154	154	1077	793	0.74	0.52
2021	401	381	273	187	261	1503	1102	0.73	0.52
TP	4897	4747	3500	2267	3480	18891	Avg	0.74	0.51

6.4. Author Productivity of GBPUAT

Table 3 illustrates, the year-by-year authorship patterns varied, showing shifting amounts of research productivity over time. Overall, there was an increase in the number of authors involved in university-published studies. The average number of authors per document was discovered to be 3.88, or roughly 4 authors per document. This shows that research at the university is conducted collaboratively, with numerous authors contributing to each publication. When author productivity was examined, the statistics revealed that the average productivity per author was 0.25. This indicator represents the average number of documents created by each author. It denotes the extent to which individual authors affiliated with Govind Ballabh Pant University of Agriculture and Technology have contributed and produced work. Furthermore, the average number of citations per manuscript was calculated to be 10.38. This

metric indicates the average number of citations received by each published manuscript. It shows the effect and influence of the university's research. The number of citations per manuscript ranged from 7.94 in 2021 to 14.22 in 2020, suggesting differences in the visibility and acknowledgement of published works over time.

The GBPUAT's author productivity. The data analysis demonstrates varying authorship patterns year after year, with a growing trend over time. The average number of authors per document was 4, and the productivity per author was 0.25. The average number of citations per manuscript was 10.38, with variances found over the years. This data gives light on the university's collaborative research activities, individual productivity, and research impact.

Table 3: Author Productivity

Year	TP	TC	TA	AAPP	ACPP
2001	113	1405	474	4.19	12.43
2002	120	1146	543	4.53	9.55
2003	183	2841	654	3.57	15.52
2004	135	1130	525	3.89	8.37
2005	166	2030	577	3.48	12.23
2006	157	1593	658	4.19	10.15
2007	173	1588	690	3.99	9.18
2008	179	1835	587	3.28	10.25
2009	206	1638	831	4.03	7.95
2010	233	2979	876	3.76	12.79
2011	272	2847	1136	4.18	10.47
2012	262	3357	1052	4.02	12.81
2013	284	3292	1124	3.96	11.59
2014	256	2519	1003	3.92	9.84
2015	265	3193	1095	4.13	12.05
2016	307	3688	1159	3.78	12.01
2017	337	3263	1207	3.58	9.68
2018	308	2662	1214	3.94	8.64
2019	256	2833	906	3.54	11.07
2020	284	4038	1077	3.79	14.22
2021	401	3182	1503	3.75	7.94
Total	4897	53059	18891	3.88	10.89

TP= Total Papers, TC= Total Citations, TA=Total Authors, AAPP= Average Author per Paper, ACPP= Average Citation per Paper

6.5 Top Cited Documents in GBPUAT

Table 4 presents the top 15 most cited papers from Govind Ballabh Pant University of Agriculture and Technology, which collectively received 4520 citations, accounting for approximately 8.51% of all citations in the study. These papers were published in 13 different sources, with the most cited journals being *Field Crops Research* and *Diabetes and Metabolic Syndrome: Clinical Research and Reviews*. The highest-cited paper, "Lignocellulosic agriculture wastes as biomass feedstocks for second-generation bio-ethanol production" by Saini et al., published in *3 Biotech Journal* in 2015, garnered 652 citations. Other notable papers include "How extensive are yield declines in long-term rice-wheat experiments in Asia?" by Ladha et al. (411 citations) and "Industry 4.0 technologies and their applications in fighting the COVID-19 pandemic" by Javaid et al. (376 citations). Additionally, five papers exceeded 300 citations, reflecting the significant impact of these publications within their respective fields. These findings underscore the substantial influence of a select number of journals and highlight key research contributions from the university.

Table 4: Most Cited Papers

Author	Year	Title	Citation	Source
Saini J.K., et al.	2015	Lignocellulosic agriculture wastes as biomass feedstocks for second-generation bioethanol production: concepts and recent developments	652	3 Biotech
Ladha J.K., et al.	2003	How extensive are yield declines in long-term rice-wheat experiments in Asia?	411	Field Crops Research
Javaid M., et al.	2020	Industry 4.0 technologies and their applications in fighting COVID-19 pandemic	376	Diabetes and Metabolic Syndrome: Clinical Research and Reviews
Singh R.P., et al.	2020	Internet of things (IoT) applications to fight against COVID-19 pandemic	365	Diabetes and Metabolic Syndrome: Clinical Research and Reviews
Sharma P., et al.	2012	Silver nanoparticle-mediated enhancement in growth and Antioxidant Status of Brassica juncea	339	Applied Biochemistry and Biotechnology
Verma S., Singh S.P.	2008	Current and future status of herbal medicines	286	Veterinary World
Bartwal A., et al.	2013	Role of Secondary Metabolites and Brassinosteroids in Plant Defense Against Environmental Stresses	262	Journal of Plant Growth Regulation
Tilak K.V.B.R., et al.	2005	Diversity of plant growth and soil health supporting bacteria	256	Current Science
Joshi D., Kumar S.	2016	Interval-valued intuitionistic hesitant fuzzy Choquet integral based TOPSIS method for multi-criteria group decision making	254	European Journal of Operational Research

Arora S., et al.	2012	Gold-nanoparticle induced enhancement in growth and seed yield of Brassica Juncea	249	Plant Growth Regulation
Magadam S., et al.	2013	Gene duplication as a major force in evolution	230	Journal of Genetics
Pandey V. and Shukla A.	2015	Acclimation and Tolerance Strategies of Rice under Drought Stress	217	Rice Science
Wrather J.A., et al.	2001	Soybean disease loss estimates for the top ten soybean-producing countries in 1998	216	Canadian Journal of Plant Pathology
Pathak H., et al.	2003	Trends of climatic potential and on-farm yields of rice and wheat in the Indo-Gangetic Plains	213	Field Crops Research
Pandey S., et al.	2017	Abiotic stress tolerance in plants: Myriad roles of ascorbate peroxidase	194	Frontiers in Plant Science

6.6 Most Prolific Measures

Table 5 highlights the top contributors and sources of research output at Govind Ballabh Pant University of Agriculture and Technology during the study period. The Most Productive Authors: Kumar, A. leads with 165 documents (3.38%), followed by Goel, R. with 86 (1.75%), and Srivastava, P.C. with 81 (1.65%), The Top Publishing Sources are: The *Indian Journal of Animal Sciences* ranks first with 281 documents (5.73%), followed by the *Indian Veterinary Journal* (164, 3.34%), and the *Indian Journal of Agricultural Sciences* (142, 2.90%), and Top Funding Agencies are: The Indian Council of Agricultural Research (ICAR) funded the most research (151, 3.08%), followed by the Department of Science and Technology (91, 1.86%), and the Department of Biotechnology (72, 1.47%). The university itself supported 70 papers (1.43%). This comprehensive analysis underscores the significant contributors, publication venues, and funding sources that drive the university's research productivity.

Table 5: Most Prolific measures

AUTHOR NAME	TP	SOURCE TITLE	TP	FUNDING SPONSOR	TP
Kumar, A.	165	Indian Journal of Animal Sciences	281	Indian Council of Agricultural Research	151
Goel, R.	86	Indian Veterinary Journal	164	Department of Science and Technology, Ministry of Science and Technology, India	91
Srivastava, P.C.	81	Indian Journal of Agricultural Sciences	142	Department of Biotechnology, Ministry of Science and Technology, India	72
Singh, S.B.	80	Journal of Food Science and Technology	101	Govind Ballabh Pant University of Agriculture and Technology	70
Goel, A.	79	Indian Journal of Agronomy	84	Council of Scientific and Industrial Research, India	60
Prakash, O.	65	Veterinary Practitioner	72	University Grants Commission	39

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Agrawal, H.M.	62	Indian Journal of Horticulture	67	Department of Biotechnology, Government of West Bengal	37
Pant, A.K.	62	Man Made Textiles in India	62	Department of Science and Technology, Government of Kerala	33
Gahlot, M.	57	Current Science	60	University Grants Committee	29
Zaidi, M.G.H.	56	Ecology Environment and Conservation	53	Science and Engineering Research Board	26
Srivastava, R.C.	52	Indian Journal of Animal Research	51	Bangladesh Council of Scientific and Industrial Research	18
Yadav, C.L.	52	3 Biotech	44	National Natural Science Foundation of China	16
Prasad, S.	51	Pestology	40	Board of Research in Nuclear Sciences	14
Gope, P.C.	48	Asian Textile Journal	38	Defence Research and Development Organisation	14
Singh, V.K.	47	Journal of Entomological Research	37	Department of Biotechnology, Ministry of Science and Technology	12

6.5. Subject-Wise Distributions

Figure 3 illustrates the distribution of research output across fields at Govind Ballabh Pant University of Agriculture and Technology (2001–2021), highlighting the top 15 subject areas. Agricultural and Biological Sciences dominate with 51% of the research, reflecting a focus on crop science, plant biology, and agricultural technology. The remaining 49% spans diverse disciplines, including engineering, environmental science, social sciences, medicine, and veterinary science, showcasing a multidisciplinary research approach. This analysis underscores the university's core strength in Agricultural and Biological Sciences while reflecting its commitment to addressing diverse scientific and socioeconomic challenges through multidisciplinary research.

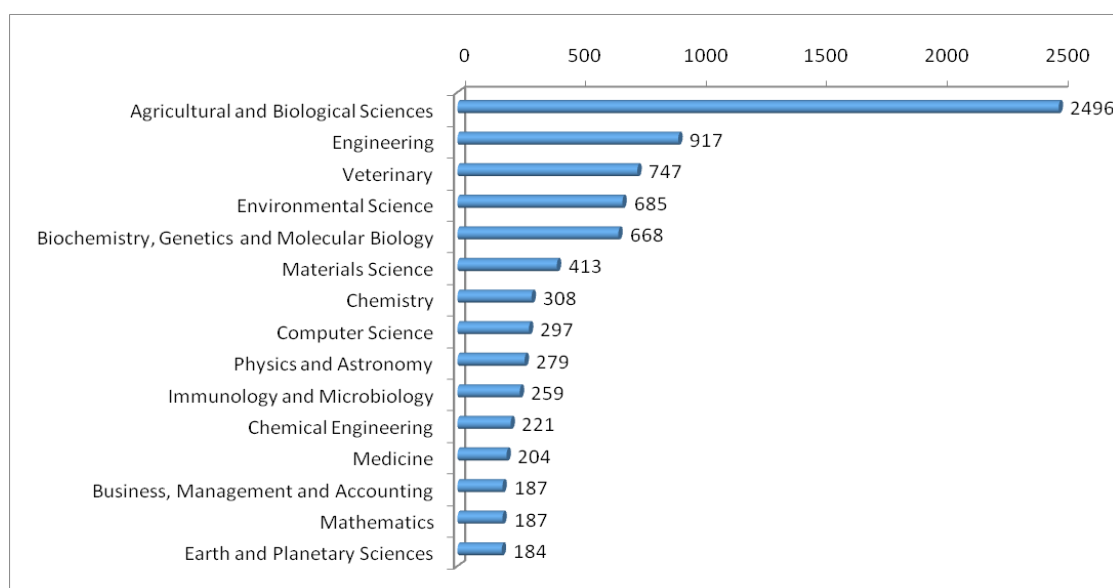


Fig 3: Subject-wise distribution

6.6. Network Visualizations of Co-Authorship Analysis of Authors

Figure 4 illustrates the network connectivity among authors, emphasizing link strength distribution. A. Kumar stands out with the highest link strength of 320. Among the 4,893 authors analyzed, 41 had at least 50 documents and 50 citations, forming distinct clusters based on shared traits or research interests. The **Cluster 1 (Red)**: The largest, featuring 11 authors, including Kumar, A., Singh, S., Sharma, A., and others. The **Cluster 2 (Green)**: Comprises 11 authors such as Singh, R., Singh, S.P., and Kumar, P. **Cluster 3 (Blue)**: Includes 7 authors like Kumar, R., Kumar, M., and Pant, A.K. The **Cluster 4 (Yellow)**: Features 5 authors, including Kumar, S., Goel, R., and Yadav, C.L. Additional smaller clusters are represented in other colors, signifying collaborative groups. This visualization highlights key contributors and collaboration patterns, offering insights into author relationships and the structure of research networks.

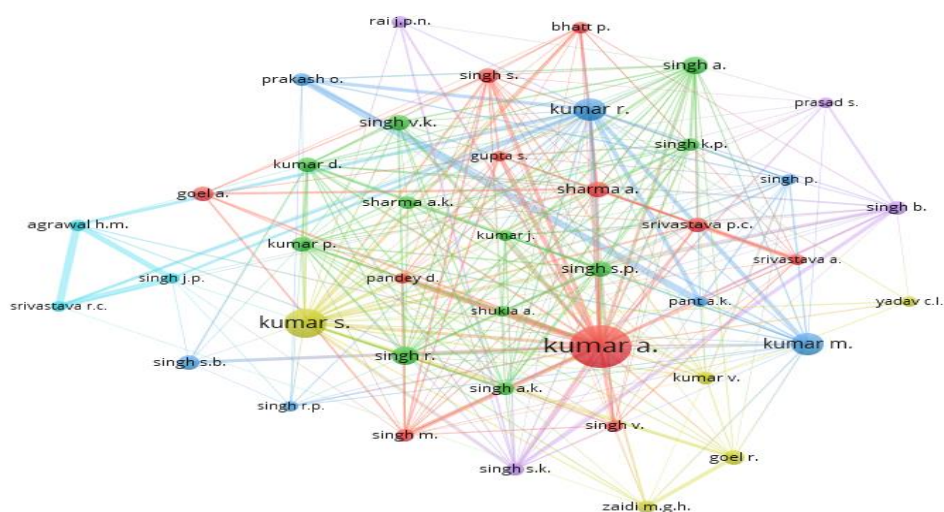


Fig 4: Authors' Network Collaborations

6.7. Occurrence Analysis of Keywords

Keywords play a vital role in publications, often influencing citations. Figure 5 highlights keyword connectivity, showing "Article" as the most prominent term with 703 occurrences and a total link strength of 6,198. Among 24,614 keywords, 258 meet the threshold of 25 occurrences, forming six clusters with at least four items each. The Cluster 1 (Red): Includes keywords like 'India' (317 occurrences, 1,928 total link strength), 'Triticum aestivum' (226 occurrences, 1,184 total link strength), and 'Rice' (137 occurrences, 936 total link strength). The Cluster 2 (Green): Focuses on 'Wheat' (175 occurrences, 1,119 total link strength), 'Metabolism' (137 occurrences, 1,639 total link strength), and 'Genetics' (114 occurrences, 1,442 total link strength). Cluster 3 (Blue): Features 'Article' (703 occurrences, 6,198 total link strength), 'Non-human' (577 occurrences, 5,193 total link strength), and 'Controlled study' (347 occurrences, 3,425 total link strength). Other clusters represent distinct concepts in varying colors, offering insights into thematic trends and keyword relationships.

3. **Promote Open-Access Publishing and Knowledge Commercialization:** Encouraging faculty and researchers to publish in open-access journals can enhance the visibility and impact of their work. Additionally, establishing frameworks for the commercialization of research outputs can lead to greater societal and economic contributions.
4. **Focus on External Funding:** Monitoring research impact systematically, alongside seeking external funding, will allow GBPUAT to support larger, more ambitious projects. Securing funding from government, industry, and international bodies can enable the university to tackle high-priority research areas and maintain its competitive edge.

CONCLUSION

GBPUAT has demonstrated commendable research productivity, contributing significantly to agriculture and technology. Collaborative research and impactful publications in high-quality journals highlight its strong research culture. Addressing areas for improvement, such as interdisciplinary efforts and portfolio diversification, can further enhance its output and reputation. This analysis provides actionable insights for institutional development, funding allocation, and research policy. By building on its strengths and addressing gaps, GBPUAT can sustain its leadership in agricultural research, addressing societal and industry demands effectively

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