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SCIENTOMETRIC DIMENSIONS OF RESEARCH PRODUCTIVITY OF THE BOTANY DEPARTMENT, DURING 1960-2000.

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Scientometric Dimensions of Research Productivity of the Botany Department from 1960-2000

Abstract

Bibliometric analysis for 160 theses and 739 thesis articles collected from the Botany Department at The University of Burdwan in eight subdivisions of Botany during 1960-2000 has been carried out to determine year wise productivity, authorship pattern and collaboration. The study has identified that the highest number of thesis submission was 40 during 1981-1985 and the highest number of article submission was 189 during 1976-1980. The highest 22 number of theses were guided by Balen Nandi. Authorship trend is towards multiauthored papers. The Degree of Collaboration is 0.70. The most prolific author was M.A Choudhuri who topped the list with 54 papers during the period 1960-2000 followed by A Mukherjee with 48 publications, P.S Basu with 31 publications, K Gupta with 30 publications and B Nandi, with 27 publications. Among the top ranking journals publishing the papers are from India with 373 (50.47 %) publications followed by Germany with 61(8.29 %) publications, China with 53 (7.17 %) publications and Netherlands with 45(6.09 %) publications.

Introduction

To know the research and development activity of an Institution evaluation plays a very vital role. Generally the numbers of publication produced by scientists, institutions, or research groups indicate the productivity indicator. This productivity indicator will highlight the contribution of the Institution or department as well as the contribution of all the individual scientists engaged in research activity.

India invests a huge amount of money and time for the production of doctorates to meet its R&D needs. Very few studies have been made to compare and evaluate the research output of the universities and R&D organizations of West Bengal. Evaluation of research institutions is very important for their ranking, proper funding, grant releasing etc. In recent past NAAC started evaluation of overall activities of the universities of our country. In a 5 to 1 star ranking by NAAC, The University of Burdwan received 4 star status, which is later revised to B+.

Although there are thirteen state universities, one deemed university and one central university in West Bengal at present, there are only six state universities in West Bengal imparting advanced studies in Pure Sciences at P.G. and research level for more than two decades. The University of Burdwan was established in 1960s as a rural base university. Since then it has made a considerable contribution in the field of Pure Sciences research among the six universities.

However, no specific effort has earlier been made to evaluate the research contributions in Botany of the university. In the present work an attempt will be made to study the contribution of The University of Burdwan in Botanical science research in West Bengal. This study will also provide some insights into the complex dynamics of research activity and enable the science policy makers and science administrators to provide adequate facilities and direct the research activities in a proper direction.

Literature review

In a study of the literature Use Pattern by the Researchers in the Field of Botany: A Citation Study of Doctoral Theses, Maheswarappa and Prakash (1982) analysed 2726 references from fifteen doctoral theses in Botany accepted by Mysore University during 1973-1980. They found out the bibliographic forms used, ranked list of core journals, self citation pattern, obsolescences and applicability of Bradford's Law. The average self-citation rate was 3.22%.

Mahapatra (1983) in his thesis prepared a rank list of Botany journals analyzing 17802 journal articles. Maheswarappa and Nagappa (1984) studied the Indian phytopathology literature. After analysing 20 dissertations of plant pathology of Rajendra Agricultural University. Lal and Panda (1996) created a ranked list of the 100 most frequently cited core periodicals.

Thomas (1990) reports on a preliminary citation analysis of the literature of systematic Botany (plant taxonomy) based on 1986 issues of 3 periodicals: *Brittonia*; *Systematic Botany* and *Taxon*.

Lal (1993) reported the results of a bibliometric analysis of 4136 citations of articles published in the 5 volumes of the *Indian Journal of Genetics and Plant Breeding* for the period 1985 to 1989. He prepared a rank list of the 60 most cited primary periodicals representing 66.86 per cent of the total citations prepared. He has also illustrated the contribution of Indian and foreign theses and the authorship pattern revealing that multi authored papers were more in practice.

Objectives

The main aim of this study is to map and evaluate the contributions of The University of Burdwan in Botanical Science research in West Bengal by investigating the characteristic features of the research and analyzing the contributions of researchers. In order to achieve this, the following objectives are set:

1. To analyse the trend of doctoral research in Botany in the University of Burdwan during 1960-2000,
2. To find out year wise publication productivity,
3. To study the pattern of authorship collaboration in the papers of Botany in the university,
4. To identify the most prolific authors of the Botany department and their Impact,
5. To identify the citation scenario of the outstanding authors of Botany,
6. To identify the journal preference of the researchers in which they have communicated their research findings,
7. To find out the country wise distribution of journals.

Methodology

In order to create the bibliographic database of the research contribution of the University of Burdwan in Botanical Science, 160 doctoral dissertations submitted to this University from 1960 to 2000, the published articles appended

in these theses and the articles reported in the Annual Reports were taken as the input for the study.

All the bibliographic details of those theses and related articles were noted on separate 8 X 5 inches slips. A computerized database is then created for in-depth analysis.

Analysis

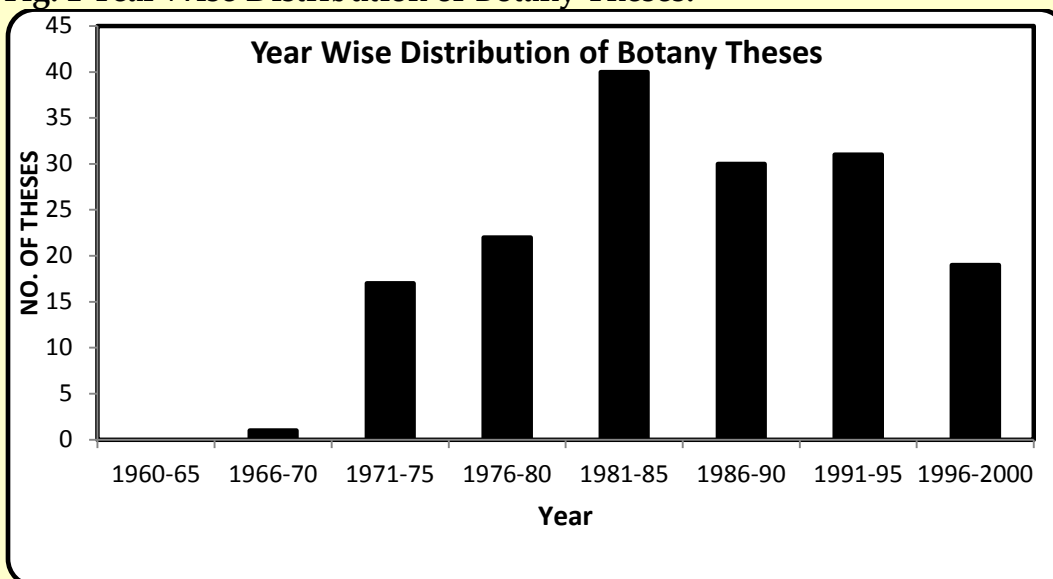
Year wise distribution of Botany Theses.

Table – 1, give year wise thesis productivity of the Botany Department of this University. During the time span 1981-1985 the highest 40 number theses were submitted. Table – 1 and Fig. – 1 indicates the year wise thesis submission over a five year grouping.

Table 1

Year Wise Distribution of Botany Theses:

Year	No. of Theses
1960-65	0
1966-70	1
1971-75	17
1976-80	22
1981-85	40
1986-90	30
1991-95	31
1996-2000	19
Total	160

Fig. 1 Year Wise Distribution of Botany Theses:

Year wise distribution of Botany theses guided by different supervisors over different time period.

Year wise distribution of Botany theses guided by different supervisors over different time period is given in Table : - 2. The highest 22 number of theses were guided by Balen Nandi.

Table 2. Year wise distribution of Botany theses guided by different supervisors over different time period.

Sl. No	Supervisor	1966-1970	1971-1975	1976-1980	1981-1985	1986-1990	1991-1995	1996-2000	Total	Span of Teaching
1	Balen Nandi		1	4	5	3	7	2	22	1970-2000 (30yrs)
2	Ajit Kumar Banerjee		4	2	6	3	1	2	18	1966-1995 (29yrs)
3	Salil Kumar Chatterjee	1	7	5	3	1			17	1973-1977 (04yrs)
4	Manojit Acharyya Chaudhuri			1	6	4	3	1	15	1970-2000 (30yrs)
5	Param Nath Bhaduri		5	5	2				12	1978-1989 (11yrs)
6	Siba Prasad Chatterjee				4	5	3		12	1974-2000 (26yrs)
7	Kajal Gupta				6	1	2	2	11	1974-2000 (26yrs)
8	Saurendra Kumar Roy			1	3	5		1	10	1966-1975 (09yrs)
9	Priti Sadhan Basu				1	6		2	9	1975-2000 (25yrs)
10	Pushpendu Bairagi			1	1	3			5	1971-1991 (20yrs)
11	Pranjit Sarma					2	1	1	4	1964-2000 (36yrs)
12	Debiprasad Kushari						4		4	1975-2000 (25yrs)
13	Paragranjan Dasgupta					1	1		2	1986-1995 (09yrs)
14	Anjali Ray			1	1				2	1974-1990 (16yrs)
15	Arun Kumar Biswas						2		2	College Teacher
16	Radhanath Mukherjee						1	1	2	1981-2000 (19yrs)
17	Pankaj Kumar Pal						1	1	2	1985-2000 (15yrs)
18	Prodyot Bhanja				1	1			2	1974-1997 (23yrs)
19	Prasanta Kr. Mukheee				1				1	1981-2000 (19yrs)
20	Narayan Ch. Chatterjee							1	1	1991-2000 (09yrs)

21	Madhuri Some							1	1971-2000 (29yrs)
22	Sakuntala Nandi						1	1	1981-1993 (12yrs)
23	Ambarish Mukherjee						1	1	1993-2000 (07yrs)
24	Samir Ch. Rakshit				1			1	1975-1978 (03yrs)
25	Prasanta Kr. Bhattacharjee					1		1	1981-2000 (19yrs)
26	U. Sen			1				1	1970-1997 (27yrs)
27	Independently			1				1	
							Total	160	

5.1.2 Sub Division wise distribution of Botany theses over different time periods.

During 1960 to 2000 the Botany Department at The University of Burdwan contributed significantly to the following main Sub Divisions of Botany.

1. PLANT PHYSIOLOGY
2. MICROBIOLOGY
3. CYTOGENETICS
4. PALEOBOTANY
5. ECOLOGY
6. PHYCOLOGY
7. PTERIDOLOGY
8. TAXONOMY

The Sub Division wise distribution of Botany theses over different time periods is shown in Table – 3. The highest number of theses (58) was submitted in Plant Physiology followed by Microbiology (55), Cytogenetics (22), Paleobotany (8) and Ecology (7), respectively.

Table 3

Sub Division wise distribution of Botany theses over different time periods.

Subject	1966-1970	1971-1975	1976-1980	1981-1985	1986-1990	1991-1995	1996-2000	Total
Plant Physiology	1	7	6	17	14	7	6	58
Microbiology		5	7	16	6	13	8	55
Cytogenetics		5	7	4	4	1	1	22
Paleobotany				2	3	1	2	8
Ecology					1	6		7
Phycology					2	1	1	4
Pteridology			1			1	1	3
Taxonomy			1	1		1		3
							Total	160

5.2 Year wise distribution of Botany articles over different time period.

Year wise distribution of Botany articles over different time period is presented in Table - 4 and Fig. - 2 respectively. The growth of publication is reached highest in 1976-80 with 189 articles followed by 1991-95 with 150 articles, 1986-90 with 149 and 1996-2000 with 141 articles.

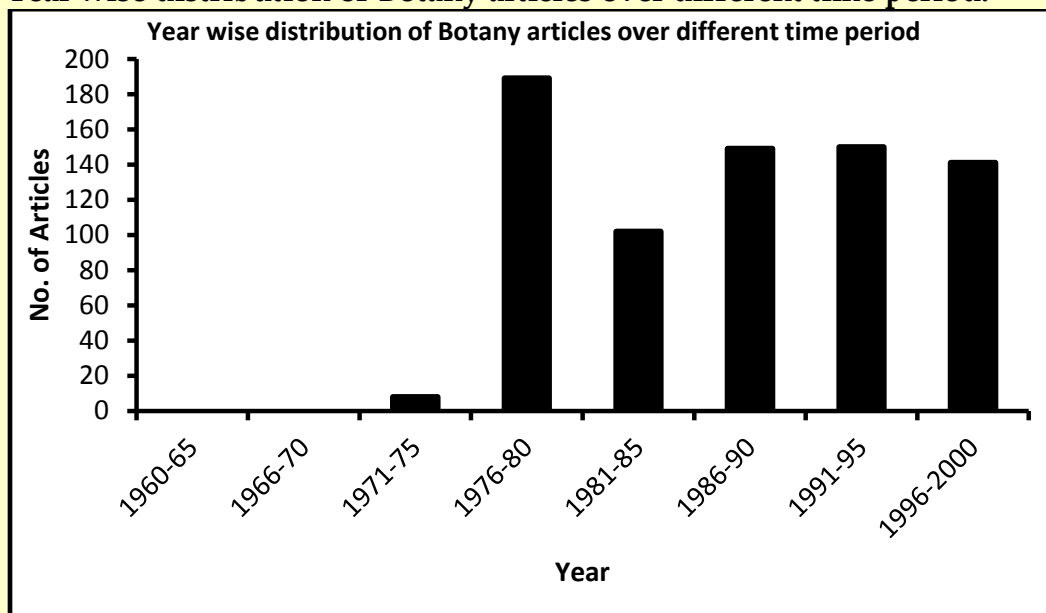
Table - 4

Year wise distribution of Botany articles over different time period.

Year	No. of Articles
1960-65	0
1966-70	0
1971-75	8
1976-80	189
1981-85	102
1986-90	149
1991-95	150
1996-2000	141
Total	739

Fig. - 2

Year wise distribution of Botany articles over different time period.



5.3 Authorship characteristics of thesis articles in Botany.

Authorship pattern and No. of publication is presented in Table – 5 & Fig. – 3. Authorship trend is towards multi-authored papers. Two authored papers account for 51.42 % followed by three authored papers 10.01 % and four authored papers 0.95 %. There are as many as six authored papers which indicate the multidisciplinary nature of research activity.

Degree of collaboration among co-authors:- The degree of collaboration among authors is measured by the following formula given by Subramanyam (1983).

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

Where C = Degree of Collaboration.

Nm = Number of multi authored article.

Ns = Number of single authored article.

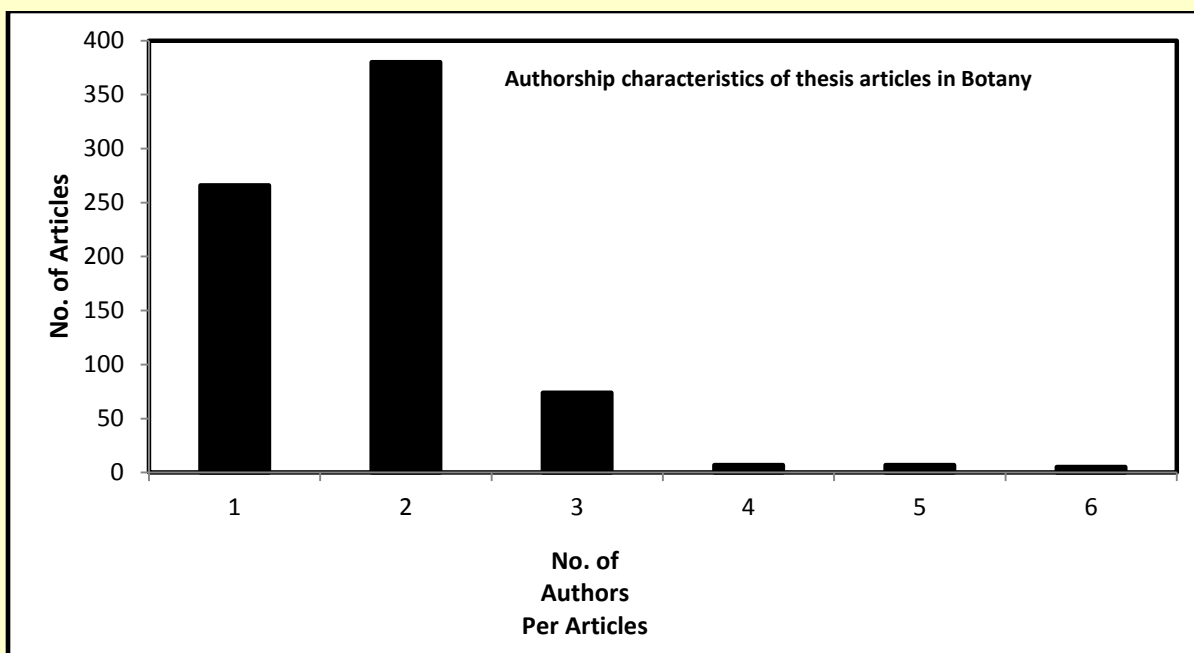
In present study The Degree of Collaboration C = 0.70

Table - 5. Authorship characteristics of thesis articles in Botany

No. of Authors Per Articles	No. of Articles	Total No. of Articles	Percentage	Cumulative Percentage
1	266	266	35.99	35.99
2	380	646	51.42	87.42
3	74	720	10.01	97.43
4	7	727	0.95	98.38
5	7	734	0.95	99.32
6	5	739	0.68	100.00

Fig. – 3

Authorship characteristics of thesis articles in Botany



5.4 Most Prolific Authors (according to 1st author).

The most prolific author was M.A Choudhuri who topped the list with 54 papers during the period 1960-2000 followed by A Mukherjee with 48 publications, P.S Basu with 31 publications, K Gupta with 30 publications and B Nandi with 27 publications. Table - 6 provides a ranked list of 133 authors with 739 publications. Out of 133 authors only 45 authors have at least 5 publications. Fig. - 4 present the publications of top ten highly prolific authors.

Table - 6

Author ranking of Botany articles (according to 1st author only).

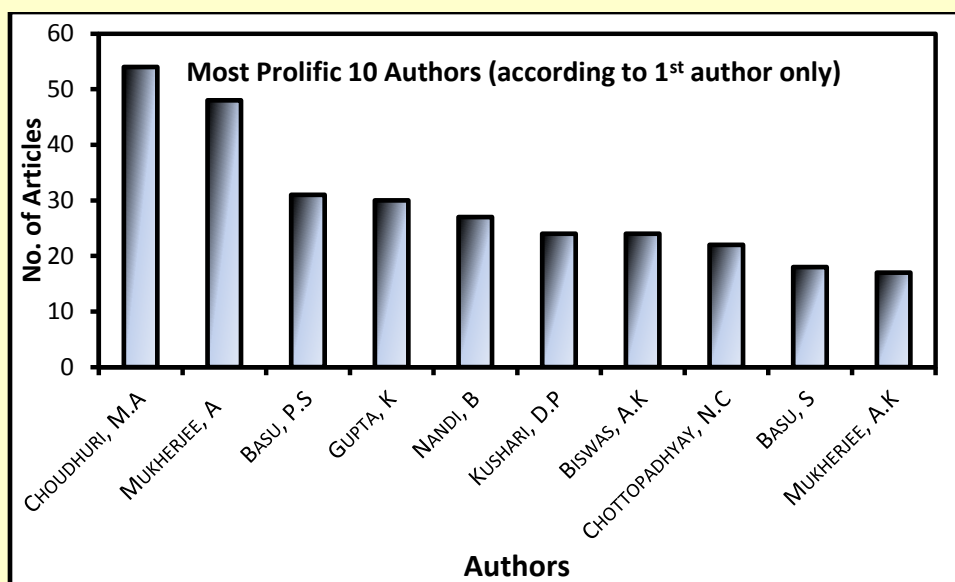
Sl.No	Rank No	Author Name	No. of articles	Cumu lNo	Per cent	Cumul percent
1	1	Choudhuri, M.A	54	54	7.307	7.307
2	2	Mukherjee, A	48	102	6.495	13.802
3	3	Basu, P.S	31	133	4.195	17.997
4	4	Gupta, K	30	163	4.060	22.057
5	5	Nandi, B	27	190	3.654	25.711
6	6	Kushari, D.P	24	214	3.24	28.959

					8	
7	6	Biswas, A.K	24	238	3.24 8	32.207
8	8	Chottopadhyay, N.C	22	260	2.97 7	35.184
9	9	Basu, S	18	278	2.43 6	37.620
10	10	Mukherjee, A.K	17	295	2.30 0	39.920
11	10	Mallick, E.H	17	312	2.30 0	42.220
12	10	Chatterjee, S.P	17	329	2.30 0	44.520
13	13	Khan, R.I	14	343	1.89 4	46.414
14	14	Mukhopadhyay, R	13	356	1.75 9	48.173
15	14	Ghosh, M.L	13	369	1.75 9	49.932
16	16	Pal, P.K	11	380	1.48 8	51.420
17	17	Roy, S.K	10	390	1.35 3	52.773
18	18	Mukherjee, S.P	9	399	1.21 8	53.991
19	18	Banerjee, A.K	9	408	1.21 8	55.209
20	18	Jana, S	9	417	1.21 8	56.427
21	21	Bhattacharya, A	8	425	1.08 3	57.510
22	21	Ghosh, S	8	433	1.08 3	58.593
23	21	Ghosh, A.K	8	441	1.08 3	59.676
24	21	De, P.S	8	449	1.08 3	60.759
25	21	Kar, C	8	457	1.08 3	61.842
26	21	Taheruzzaman, Q	8	465	1.08 3	62.925
27	27	Begam, H.H	7	472	0.94	63.872

					7	
28	27	Barua, B	7	479	0.94 7	64.819
29	27	Banja, P	7	486	0.94 7	65.766
30	27	Roy, S	7	493	0.94 7	66.713
31	31	Sharma, P	6	499	0.81 2	67.525
32	31	Acharya, S	6	505	0.81 2	68.337
33	31	Bhandari, J.B	6	511	0.81 2	69.149
34	31	Kole, S	6	517	0.81 2	69.961
35	31	Pal, J	6	523	0.81 2	70.773
36	31	Bairagi, P	6	529	0.81 2	71.585
37	31	Mondal, W.A	6	535	0.81 2	72.397
38	38	Chattopadhyay, K.K	5	540	0.67 7	73.074
39	38	Chatterjee, M	5	545	0.67 7	73.751
40	38	Chakraborty, N	5	550	0.67 7	74.428
41	38	Kar, R.K	5	555	0.67 7	75.105
42	38	Sinha, B.K	5	560	0.67 7	75.782
43	38	Roychoudhuri, S	5	565	0.67 7	76.459
44	38	Mitra, S	5	570	0.67 7	77.136
45	38	Das, T.K	5	575	0.67 7	77.813
46-55	46	10 authors with 4 articles each	4	615	0.54 1	83.223
56-69	56	14 authors with 3 articles each	3	657	0.40 6	88.907
70-87	70	18 authors with 2	2	693	0.27	93.785

		articles each			1	
88-133	88	46 authors with 1 article each	1	739	0.135	99.995

Fig. 4. Most Prolific Authors (according to 1st author only).



Co authorship and credit study for the individual author's in Botany

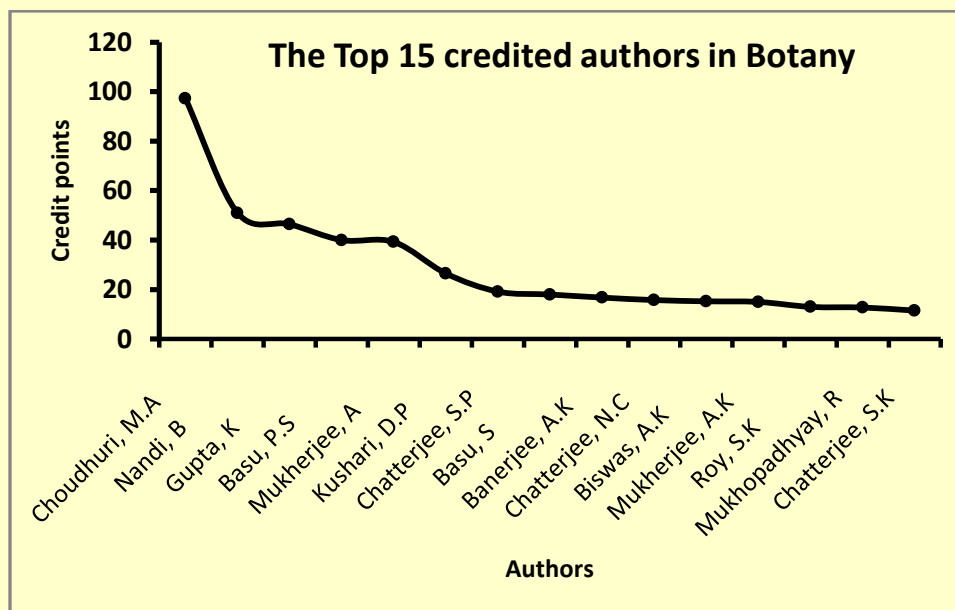
The co authorship of an author is calculated by taking the number of papers published by the author as first, second, third or more authors. The credit is given to the second author onwards is 0.5 while the first author is given 1. The ranked list of authors according to their credit is shown in Table - 7. The most credited author was M.A Choudhuri who topped the list with 97.25 points, B Nandi with 51 points, K Gupta with 46.4167 points, P.S Basu with 40 points and. The authors get minimum 5 credit points are only taken into consideration for preparing the ranked list. Fig - 5 represents the top 15 credited authors.

Table 7. Authorship and credit study for the individual author's in Botany.

Serial No.	Rank No.	Author's Name	Total Credit
1	1	Choudhuri, M.A	97.2500
2	2	Nandi, B	51.0000
3	3	Gupta, K	46.4167
4	4	Basu, P.S	40.0000
5	5	Mukherjee, A	39.2500
6	6	Kushari, D.P	26.5000
7	7	Chatterjee, S.P	19.1667
8	8	Basu, S	18.0000

9	9	Banerjee, A.K	16.7500
10	10	Chatterjee, N.C	15.7500
11	11	Biswas, A.K	15.2500
12	12	Mukherjee, A.K	15.0000
13	13	Roy, S.K	13.0000
14	14	Mukhopadhyay, R	12.7500
15	15	Chatterjee, S.K	11.5000
16	16	Mallick, E.H	11.0000
17	17	Bairagi, P	8.7500
18	18	Pal, P.K	8.0000
19	19	Khan, R.I	7.0000
20	20	Ghosh Hazra, N	6.7500
21	21	Ghosh, M.L	6.5000
22	21	Taheruzzaman, Q	6.5000
23	23	Ghosh, A.K	6.3334
24	23	Banja, P	6.0000
25	25	Ghosh, A	5.2500

Fig. 5. The Top 15 credited authors in Botany.



Author's impact in Botany (according to 1st authors).

The Impact of an author with reference to a journal is calculated by taking the number of papers published by the author in the journal multiplied by the average Impact Factor of the journal. The total impact of an author is calculated by summing all such values with reference to that author. The ranked list of

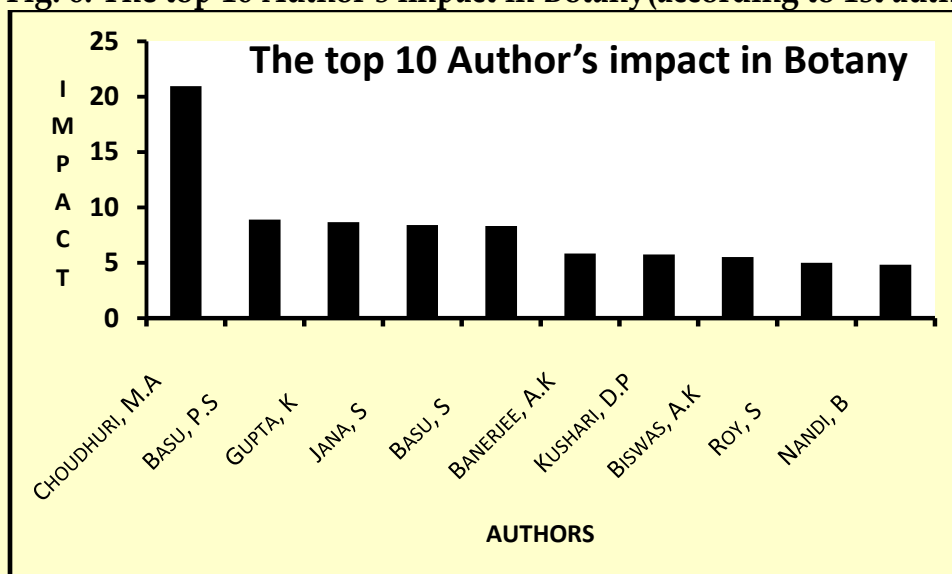
authors according to their impact is given in Table – 8 and Fig. - 6. The Impact Factors of the journals are as per "SCIENCE JOURNAL RANKING BY AVERAGE IMPACT FACTORS, Version 2002" Created by Acad. Prof. Dr. Ioan-Iovitz Popescu Based on ISI annual datasets of SCI-JCR(1974-2000). Popescu Ioan-Iovitz (2002).

Table 8. Author's impact in Botany (according to 1st authors).

Sl. No.	Author's Name	Total Impact of the author	Sl. No.	Author's Name	Total Impact of the author
1	Choudhuri, M.A	20.93	46	De, P.S	0.89
2	Basu, P.S	8.89	47	Chowdhuri, K	0.82
3	Gupta, K	8.65	48	Ghosh, A	0.81
4	Jana, S	8.40	49	Roy, D.K	0.80
5	Basu, S	8.33	50	Roy, M	0.80
6	Banerjee, A.K	5.83	51	Dey, B.B	0.79
7	Kushari, D.P	5.75	52	Medya, R	0.77
8	Biswas, A.K	5.52	53	Middya, R.N	0.77
9	Roy, S	4.99	54	Begam, H.H	0.75
10	Nandi, B	4.83	55	Mallick, E.H	0.70
11	Khan, R.I	4.56	56	Santra, S	0.70
12	Mukherjee, A.K	4.47	57	Banerjee, S	0.67
13	Mukherjee, A	3.13	58	Singh, S	0.60
14	Kar, C	2.61	59	Bose, A	0.54
15	Sarkar, B.L	2.56	60	De, A.B	0.52
16	Sinha, B.K	2.48	61	Banja, P	0.49
17	Chottopadhyay, S.P	2.31	62	Sarma, P	0.49
18	Dangar, T.K	2.12	63	Mitra, S	0.48
19	Roy, S.K	2.09	64	Biswas, D	0.40
20	Mukherjee, S.P	1.89	65	Hati, T.K	0.40
21	Banerjee, A	1.85	66	Mukhopadhyay, R	0.36
22	Chattopadhyay, K.K	1.84	67	Bandyopadhyay, A	0.35
23	Barua, B	1.64	68	Basu, P	0.35
24	Ghosh, M.L	1.55	69	Sadhu, B.P	0.35
25	Bhowmik, P.K	1.53	70	Ghosh, A.K	0.34
26	Chottopadhyay, N.C	1.45	71	Sharma, P	0.34
27	Bhattacharya, A	1.39	72	Bhattacharya, B	0.32

28	Acharya, S	1.31	73	Chottopadhyay, S.K	0.29
29	Kundu, P.K	1.31	74	Dasgupta, P.K	0.28
30	Ghosh, S	1.28	75	Chakraborty, N	0.26
31	Nandi, D.K	1.21	76	Chatterjee, S	0.25
32	Mondal, R	1.20	77	Mukherjee, P.S	0.25
33	Mondal, W.A	1.18	78	Bairagi, P	0.21
34	Mondal, W	1.12	79	Pal, P	0.21
35	Das, T.K	1.10	80	Pal, R	0.21
36	Choudhuri, R	1.07	81	Mukhopadhyay, S	0.20
37	Mondal, G.C	1.02	82	Roy, M.B	0.19
38	Sarkar, P.K	0.97	83	Bhandari, J.B	0.18
39	Konar, J	0.96	84	Mukherjee, R	0.18
40	Taheruzzaman, Q	0.96	85	Pathak, S	0.06
41	RoyChoudhuri, S	0.94	86	Saha, K	0.06
42	Kole, S	0.92	87	Keshri, J.P	0.04
43	Bhattacharya, R.N	0.91	88	Ghosh Hazra, N	0.03
44	Kalam, A	0.91	89	Mallick, N.H	0.03
45	Kar, K	0.91			

Fig. 6. The top 10 Author's impact in Botany(according to 1st authors).



Author's impact in Botany (considering all author positions).

The total credit given for a paper is one. For a single authored article the author is given a credit point of one. For a double authored article each author is given a credit point of 0.5. For a multi-authored paper the first author is given a credit point of 0.5 and 0.5 credit point is distributed dividing equally among the other authors.

The Impact of an author (Table - 9, Fig. - 7) with reference to a journal is calculated by taking such credit point of an author earned for papers published in that journal multiplied with the average Impact Factor of the journal. The total impact of an author is calculated by summing all such values with reference to that author. The average Impact Factors of the journals are taken as per Popescu Ioan-Iovitz (2002).

The ranked list of authors according to their credit is shown in Table - 9. The most credited author was M A Choudhuri who topped the list with 34.4725 points, followed by P S Basu with 10.8175 points, K Gupta with 10.7033 points and B Nandi with 9.1750 points. The authors get minimum 0.5 points are only taken into consideration for preparing the ranked list. Fig. - 7 represents the top 10 credited authors.

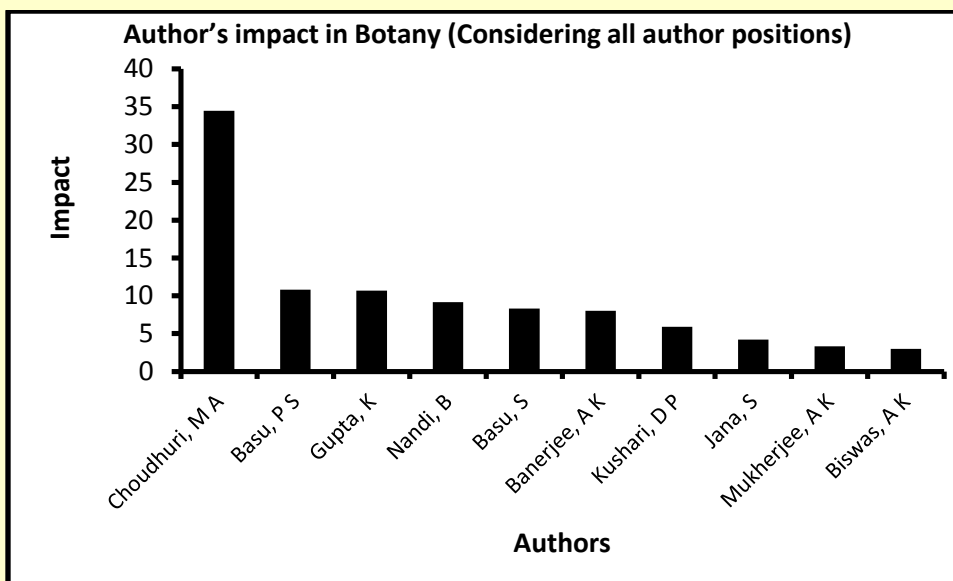
Table 9. Author's impact in Botany (Considering all author positions).

Serial No.	Rank No.	Author's Name	Total Impact of the author
1	1	Choudhuri, M A	34.4725
2	2	Basu, P S	10.8175
3	3	Gupta, K	10.7033
4	4	Nandi, B	9.1750
5	5	Basu, S	8.3300
6	6	Banerjee, A K	8.0350
7	7	Kushari, D P	5.8900
8	8	Jana, S	4.2000
9	9	Mukherjee, A K	3.3400
10	10	Biswas, A K	2.9925
11	11	Chatterjee, S P	2.7100
12	12	Roy, S	2.4950
13	13	Mukherjee, A	2.4600
14	14	Khan, R I	2.2800

15	15	Roy, S K	2.2700
16	16	Chatterjee, S K	1.8425
17	17	Anderson, J D	1.5500
18	18	Kar, C	1.4300
19	19	Sinha, B K	1.3275
20	20	Sarkar, B L	1.2800
21	21	Mondal, S K	1.2534
22	22	Taheruzzaman, Q	1.1700
23	23	Banerjee, A	1.1250
24	24	Dangar, T K	1.0600
25	25	Das, S	0.9675
26	26	Mukherjee, S P	0.9450
27	27	Bhattacharya, S	0.9250
28	28	Barua, B	0.8500
29	29	Ghosh, A	0.8225
30	30	Ghosh, A C	0.8100
31	31	Chottopadhyay, N C	0.7900
32	31	Ghosh, S	0.7900
33	33	Ghosh, M L	0.7750
34	34	Bhowmik, P K	0.7650
35	35	Mishra, A	0.7600
36	36	Bhattacharya, A	0.7425
37	37	Bhattacharya, R N	0.7300
38	38	Begam, H H	0.6750
39	38	Dey, B B	0.6750
40	40	Banerjee, S	0.6675
41	41	Sharma, P	0.6600
42	42	Acharya, S	0.6550
43	42	Kundu, P K	0.6550
44	44	Bhanja, P	0.6250
45	45	Das, T K	0.6125
46	46	Nandi, D K	0.6050
47	47	Mondal, R	0.6000
48	48	Mondal, W A	0.5900
49	49	Chottopadhyay, K K	0.5850
50	50	Chowdhuri, K	0.5700
51	51	Mondal, W	0.5600
52	52	Chatterjee, K K	0.5400

53	52	Mukhopadhyay, R	0.5400
54	54	Choudhuri, R	0.5350
55	55	RoyChoudhuri, S	0.5175
56	56	Mondal, G C	0.5100

Fig. 7. Author's impact in Botany (Considering all author positions).



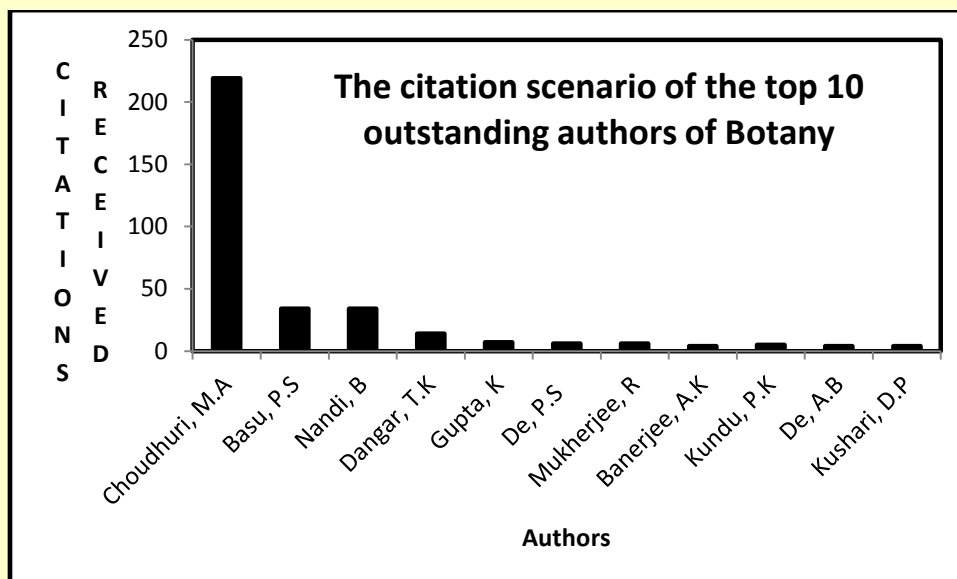
The citation scenario of the outstanding authors of Botany.

The citations of the published articles of Botany researchers are collected from Scopus™. It has wider scope than Science Citation Index. Research papers from non-SCI journals also indexed in it makes an important point. As for example 2000 CD/print edition of SCI has covered 10 Indian journals and its web version called Expanded version (via Web of Science through Internet) has 51 journals whereas Scopus TM covered 168 Indian journal. Jain, N.C (2005).

From Table - 10, Fig. - 8 it is evident that M.A. Choudhuri received highest number of citations (233), with only 14 numbers of self citations whereas P.S Basu received 75 citations, with 41 self citations during this time period. The other authors, B. Nandi received 40 (with 6 numbers of self citations), T.K Dangar received 16 (with 2 numbers of self citations) and K. Gupta received 10 (with 3 numbers of self citations).

Table 10. Citation received by the authors of published articles of Botany.

Sl. No	Rank No	Author Name	Total no of articles published	Total Citation Received	No of Citation from other authors	Self citation
1	1	Choudhuri, M.A	54	233	219	14
2	2	Basu, P.S	31	75	34	41
3	3	Nandi, B	27	40	34	6
4	4	Dangar, T.K	12	16	14	2
5	5	Gupta, K	30	10	7	3
6	6	De, P.S	8	8	6	2
7	6	Mukherjee, R	13	8	6	2
8	8	Banerjee, A.K	9	7	4	3
9	8	Kundu, P.K	1	7	5	2
10	10	De, A.B	3	6	4	2
11	11	Kushari, D.P	24	5	4	1
12	12	Roy, M	2	4	2	2
13	12	Banerjee, A	1	4	4	0
14	14	Chottopadhyay, N.C	22	3	2	1
15	15	Kar, R.K	5	2	1	1
16	15	Khan, R.I	14	2	1	1
17	17	Chattopadhyay, K.K	5	1	1	0
18	17	Mondal, W.A	6	1	1	0
19	17	Mukherjee, S.P	9	1	1	0
20	17	Pal, D.K	1	1	1	0
21	17	Saha, K	1	1	1	0
22	17	Chatterjee, S	1	1	0	0

Fig. 8. The citation scenario of the top 10 outstanding authors of Botany.

Communication Channel Preference by the Researchers of Botany Department

The leading journals preferred by the researchers of Botany department are *Indian Journal of Exp Biol* with 62 papers, *Sci Cult* with 39 papers, *Ind Jl Plant Physiol* with 36 papers, *Geobios* with 33 papers and *Fol Microbiol* with 23 papers. Table - 11 provides journal preference by the researchers of Botany Department.

Table 11. Ranked list of Botany journals preferred for publishing articles by the researchers of Botany department.

Sl. No	Rank No	Journal Name	No. of papers	Cum. No	Per Cent	Cum. percent
1	1	Ind Jl Exp Biol	62	62	8.390	8.390
2	2	Sci Cult	39	101	5.277	13.667
3	3	Ind Jl Plant Physiol	36	137	4.871	18.538
4	4	Geobios	33	170	4.465	23.003
5	5	Fol Microbiol	23	193	3.112	26.115
6	6	Seed Sci Tech	20	213	2.706	28.821
7	7	Biochem Phy Pflanz	19	232	2.571	31.392
8	7	Biol Plant	19	251	2.571	33.963
9	9	Ind Fern Jl	17	268	2.300	36.263
10	9	Env Ecol	17	285	2.300	38.563
11	11	Curr Sci	16	301	2.165	40.728

12	12	Acta Biotech	14	315	1.894	42.622
13	13	Ind Jl Myco Res	13	328	1.759	44.381
14	14	Jl Mycopath Res	11	339	1.488	45.869
15	14	Physiol Planterum	11	350	1.488	47.357
16	16	Ind Jl Pure Appl Bio	10	360	1.353	48.710
17	17	BU Sci Jl	9	369	1.218	49.928
18	17	Ind Jl Bot	9	378	1.218	51.146
19	19	Hydrobiol Bull	8	386	1.083	52.229
20	19	Geophytology	8	394	1.083	53.312
21	21	Plant Soil	7	401	0.947	54.259
22	21	Aqua Bot	7	408	0.947	55.206
23	21	Ind Jl Forestry	7	415	0.947	56.153
24	24	Ind Jl Agri Sci	6	421	0.812	56.965
25	24	Ind Jl Microbiol	6	427	0.812	57.777
26	24	Plant Physiol Bioche	6	433	0.812	58.589
27	24	Ind Biol	6	439	0.812	59.401
28	28	Plant Physiol	5	444	0.677	60.078
29	28	Phytomorphology	5	449	0.677	60.755
30	28	Ind Perfume	5	454	0.677	61.432
31	28	Microbiol Res	5	459	0.677	62.109
32	32	Jl Nat Bot Soc	4	463	0.541	62.650
33	32	Jl Swamy Bot	4	467	0.541	63.191
34	32	Flora Fauna	4	471	0.541	63.732
35	32	Proc Ind Sci Cong	4	475	0.541	64.273
36	32	Bull Bot Soc Beng	4	479	0.541	64.814
37	32	SABRAO Jl	4	483	0.541	65.355
38	32	Bio Physiol Der Pfla	4	487	0.541	65.896
39	32	Mycologia	4	491	0.541	66.437
40	32	Hind Anti Bull	4	495	0.541	66.978
41	41	Jl Basic Microbiol	3	498	0.406	67.384
42	41	Bang Jl Bot	3	501	0.406	67.790
43	41	Int Jl Plant Physiol	3	504	0.406	68.196
44	41	Trans Br Mycol Soc	3	507	0.406	68.602
45	41	Cytologia	3	510	0.406	69.008
46	41	Bot Conf	3	513	0.406	69.414
47	41	Egypt Jl Microbiol	3	516	0.406	69.820
48	41	Mush Jl	3	519	0.406	70.226
49	41	Jl Exp Biol	3	522	0.406	70.632
50	41	Ind Jl Ecol	3	525	0.406	71.038

51	41	Genet Polon	3	528	0.406	71.444
52	41	New Phytol	3	531	0.406	71.850
53	53	Experientia	2	533	0.271	72.121
...	...	29 JOURNALS	...	...	.....	.....
83	53	IRRN	2	593	0.271	80.251
84	84	Ind Jl Biochem Bioph	1	594	0.135	80.386
....	...	144 JOURNALS	...	...	.....	.....
229	84	Zeit fur Allg Mikrob	1	739	0.135	99.961

Country wise distribution of Botany journals

Country wise distribution of Botany journals preferred for publishing articles by the researchers of Botany department is presented in Table – 12. The Impact Factors of the journals are as per "SCIENCE JOURNAL RANKING BY AVERAGE IMPACT FACTORS, Version 2002" Created by Acad. Prof. Dr. Ioan-Iovitz Popescu Based on ISI annual datasets of SCI-JCR(1974-2000). Popescu Ioan-Iovitz (2002).

Table 12. Country wise origin and average IF of the journals preferred for publishing articles by the researchers of Botany department.

Sl. No	Rank No	Journal Name	No. of papers	Cum. No	Per Cent	Cum. per Cent	Country	Average IF of the journal
1	1	Ind Jl Exp Biol	62	62	8.390	8.390	India	0.25
2	2	Sci Cult	39	101	5.277	13.667	China	
3	3	Ind Jl Plant Physiol	36	137	4.871	18.538	India	0.06
4	4	Geobios	33	170	4.465	23.003	France	0.35
5	5	Fol Microbiol	23	193	3.112	26.115	U.K	0.40
6	6	Seed Sci Tech	20	213	2.706	28.821	Switzerland	0.19
7	7	Biochem Phy Pflanz	19	232	2.571	31.392	Germany	0.60
8	7	Biol Plant	19	251	2.57	33.963	Netherland	0.32

					1		s	
9	9	Ind Fern JI	17	268	2.30 0	36.263	India	
10	9	Env Ecol	17	285	2.30 0	38.563	India	0.48
11	11	Curr Sci	16	301	2.16 5	40.728	India	0.26
12	12	Acta Biotech	14	315	1.89 4	42.622	Germany	
13	13	Ind JI Myco Res	13	328	1.75 9	44.381	India	
14	14	Jl Mycopath Res	11	339	1.48 8	45.869	India	
15	14	Physiol Planterum	11	350	1.48 8	47.357	Denmark	1.64
16	16	Ind JI Pure Appl Bio	10	360	1.35 3	48.710	India	
17	17	BU Sci JI	9	369	1.21 8	49.928	India	
18	17	Ind JI Bot	9	378	1.21 8	51.146	India	
19	19	Hydrobiol Bull	8	386	1.08 3	52.229	Netherland s	
20	19	Geophytology	8	394	1.08 3	53.312	India	
21	21	Plant Soil	7	401	0.94 7	54.259	India	0.80
22	21	Aqua Bot	7	408	0.94 7	55.206	Netherland s	0.90
23	21	Ind JI Forestry	7	415	0.94 7	56.153	India	
24	24	Ind JI Agri Sci	6	421	0.81 2	56.965	India	0.03
25	24	Ind JI Microbiol	6	427	0.81 2	57.777	India	
26	24	Plant Physiol Bioche	6	433	0.81 2	58.589	India	1.21
27	24	Ind Biol	6	439	0.81 2	59.401	India	
28	28	Plant Physiol	5	444	0.67 7	60.078	U.S.A	3.22
29	28	Phytomorpholog	5	449	0.67	60.755	India	0.18

		y			7			
30	28	Ind Perfume	5	454	0.67 7	61.432	India	
31	28	Microbiol Res	5	459	0.67 7	62.109	Germany	0.39
32	32	Jl Nat Bot Soc	4	463	0.54 1	62.650	India	
33	32	Jl Swamy Bot	4	467	0.54 1	63.191	India	
34	32	Flora Fauna	4	471	0.54 1	63.732	Denmark	
35	32	Proc Ind Sci Cong	4	475	0.54 1	64.273	India	
36	32	Bull Bot Soc Beng	4	479	0.54 1	64.814	India	
37	32	SABRAO Jl	4	483	0.54 1	65.355	U.S.A	
38	32	Bio Physiol Der Pfla	4	487	0.54 1	65.896	Germany	
39	32	Mycologia	4	491	0.54 1	66.437	U.S.A	0.83
40	32	Hind Anti Bull	4	495	0.54 1	66.978	India	
41	41	Jl Basic Microbiol	3	498	0.40 6	67.384	Germany	0.43
42	41	Bang Jl Bot	3	501	0.40 6	67.790	Banglades h	0.40
43	41	Int Jl Plant Physiol	3	504	0.40 6	68.196	Germany	
44	41	Trans Br Mycol Soc	3	507	0.40 6	68.602	U.S.A	
45	41	Cytologia	3	510	0.40 6	69.008	U.K	0.21
46	41	Bot Conf	3	513	0.40 6	69.414	India	
47	41	Egypt Jl Microbiol	3	516	0.40 6	69.820	Egypt	
48	41	Mush Jl	3	519	0.40 6	70.226	U.K	
49	41	Jl Exp Biol	3	522	0.40 6	70.632	U.K	1.85
50	41	Ind Jl Ecol	3	525	0.40	71.038	India	

					6			
51	41	Genet Polon	3	528	0.40 6	71.444	Poland	0.18
52	41	New Phytol	3	531	0.40 6	71.850	U.K	1.58
53	53	Experientia	2	533	0.27 1	72.121	Switzerlan d	1.12
...	...	29 JOURNALS	...	...	..... .	.....
83	53	IRRN	2	593	0.27 1	80.251	U.S.A	
84	84	Ind Jl Biochem Bioph	1	594	0.13 5	80.386	India	0.33
...	...	144 JOURNALS	...	...	.....	.....
22 9	84	Zeit fur Allg Mikrob	1	739	0.13 5	99.961	Germany	

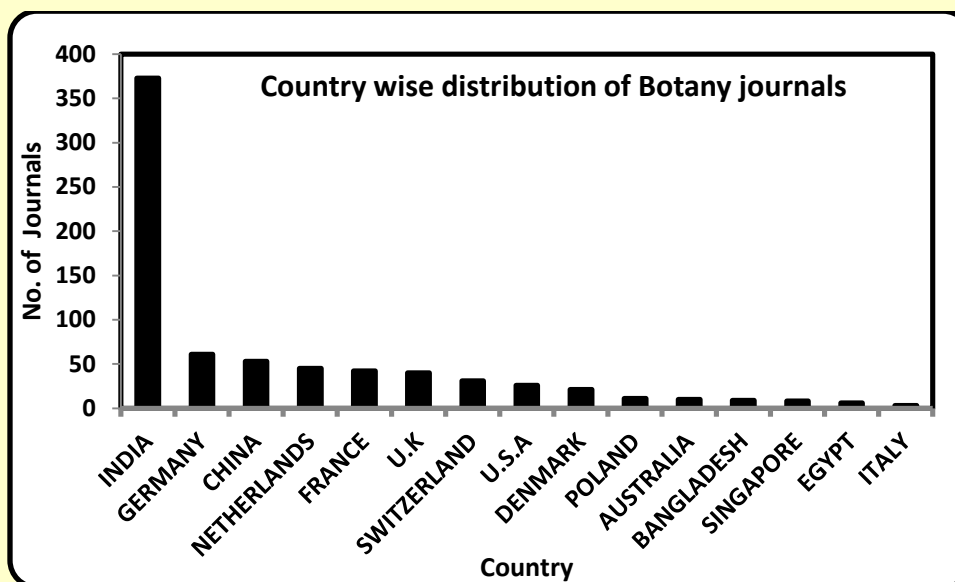
Figure 9 and Table 13 gives the country of origin and IF of the journals where the papers have been published. Among the top ranking journals publishing the papers are from India with 373 (50.47 %) publications followed by Germany with 61(8.29 %) publications, China with 53(7.17 %) publications, Netherlands with 45(6.09 %) publications, France with 42 (5.68 %) publications and U.K with 40 (5.41 %) publications.

Table 13. Country wise distribution of Botany journals preferred for publishing articles by the researchers of Botany department.

Sl.No	Rank No.	Country	Total No. of articles	Percent
1	1	INDIA	373	50.47
2	2	GERMANY	61	8.29
3	3	CHINA	53	7.17
4	4	NETHERLAND S	45	6.09
5	5	FRANCE	42	5.68
6	6	U.K	40	5.41
7	7	SWITZERLAN D	31	4.20
8	8	U.S.A	26	3.51
9	9	DENMARK	21	2.84
10	10	POLAND	11	1.48
11	11	AUSTRALIA	10	1.36

12	12	BANGLADESH	9	1.21
12	13	SINGAPORE	8	1.08
14	14	EGYPT	6	0.81
15	15	ITALY	3	0.40
		TOTAL	739	100.00

Fig. 9. Country wise distribution of Botany journals preferred for publishing articles by the researchers of Botany department.



Conclusion

This paper has highlighted quantitatively as well as qualitatively the contributions made by the researchers of Botany Department of the University of Burdwan during 1960-2000. The Department has produced 160 theses during this period with majority of theses produced during 1981-1985 in diverse areas of research such as Plant Physiology (58) followed by Microbiology (55), Cytogenetics (22) and Paleobotany (8) respectively. During this period the department has produced 739 articles with majority of these produced during 1976-1980. The collaboration trend among the Botanists towards multi-authored papers is indicative of the highly specialized areas of scientific work that they were engaged in. The most prolific authors identified in the study shows that publication productivity is one of the important indicators to identify the scientists. The publication behaviors indicates that the Botanists were highly selective in publishing their research results in highly specialized and high impact factor journals. It would be quite interesting to study other qualitative indicators based on citations and impact factors, participation in international seminars, academic qualifications and awards received by these scientists.

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