



## Research Output in the Field of Entomology (2010-2014) at PAU and CSKHPKV: A Citation Study

Saroj Bala  
Research Scholar  
Department of Library. & Information Science.  
Kurukshetra University,  
Kurukshetra.

Joginder Singh  
Professor  
Department of Library. & Information Science  
Kurukshetra University  
Kurukshetra.

### Abstract

The study covers a total 3387 citations appended to the 17 doctoral theses in the field of Entomology awarded by PAU, Ludhiana and CSKHPKV, Palampur during the year 2010-2014 to find out the comparison in terms of bibliographic forms of the cited documents, authorship pattern, country-wise, subject-wise, year-wise distribution of citations and its obsolescence value. Ranking of the cited journals was also carried out with the application of Bradford's law of scattering. It is believed that this study would be helpful for the librarians in the process of collection development and weeding out of unused documents from the libraries to save costly stocking space and reduce maintenance cost. In view of the increasing cost of the journals and the shrinking library budgets, the librarians must make careful selections based on the qualities and standards of journals.

*Keywords:* Bibliometrics, Citation analysis, Bradford's law, Entomology research output, Punjab Agricultural University

### 1. Introduction

Information is the product of human brain in action. The information should be put into proper use for socio-economic, cultural and scientific development of the country. It is not possible for any library, nor is it necessary to acquire all the published documents. Therefore, they need to apply a systematic means of objectivity in selecting what is desired in the collection development programme of the library. To know the productivity and usability of a particular resource of a particular field can be found out only by using techniques of Bibliometric analysis. Several new terms have appeared on the horizon e.g. librametrics, scientometrics, informetrics, cybermetrics, webometrics and altmetrics representing quantitative studies in the field of library and information science.

Citation analysis is an indirect method to assess the information/sources used by various categories of users. Citation analysis as a bibliometric technique in which works cited in publications are examined to determine patterns of scholarly communication, for example, the comparative importance of books versus journals, or of current versus retrospective sources, in one or more academic disciplines. The citation in student's research papers, theses, and dissertations are also examined by the librarian for the purposes of the collection evaluation and development.



There are enough historical evidences, to show that the agricultural education existed in India even during the medieval period. Agriculture as a discipline was included in the curricula of Nalanda and Takshila which were the most well known ancient universities of our country, where the agriculture education and research has had a great significance in the sustainable growth and development of human resources for the agricultural sector. The Indian Council of Agricultural Research (ICAR), the controlling agency for agricultural universities in India, has implemented a special project with the assistance of the World Bank to modernize the Library and Information Systems of all agricultural universities and the ICAR institutes in the country.

## 2. Literature Review

Singh and Bebi (2013) conducted a study on the citation analysis of PhD theses in sociology submitted to University of Delhi during 1995-2010. A total 5766 citations were analyzed from 25 PhD theses in sociology. Highest numbers of citations (67.2%) were recorded from books followed by journal articles, book chapters etc. Country-wise distribution of citations revealed that Indian literature received 2536 (45.9%) citations and ranked first, followed by USA with 1546 (26.8%). The analysis of authorship pattern in sociology theses showed that 4786 (83.9%) of citations were to papers written by single authors which implies that social sciences were less collaborative. India's Economic & Political Weekly occupied the first rank accounting for 137 (10.70%) of total journal citations followed by Indian Journal of Psychiatry (7.66%). It was also found that citations were not in standard format. Thanuskodi (2011) found the number of articles, authorship pattern, subject-wise and year-wise distribution of articles, average number of references per articles, forms of documents cited, etc of the journal 'Library Herald' for the period 2006 to 2010. The results showed that out of 138 articles, single authors contributed 72 (52.17%) articles, while rest 66 (47.83%) articles were contributed by the joint authors. Volume no.44 revealed the highest number of articles i.e.38, while the lowest number of articles is in volume no.47 i.e.18 only. Most of the contributions are from India with 89.85% and the rest 10.15% only from the foreign sources. Library Herald journal is the highly preferred journal for communication by the library professionals. Tunga and Dasgupta (2013) studied the use pattern of the cited literature in the field of horticulture by the agricultural scientists during the period of 1991-2010. A total of 10,845 citations appended to 80 doctoral theses were analyzed. Maximum theses contribution was in the department of Fruits and Orchard Management whereas maximum numbers of theses were submitted on 'Mango' crop. Most of the cited journals belonged to India followed by USA. Bradford's Law did not fit well in journals and half- life of the journal articles was found to be 24 years. Zafrunnisha (2012) and Singh and Bebi (2014) further conducted a study on the application of the Bradford's law in the journals of Psychology and social sciences. Their studies covered 141 and 260 doctoral theses total in numbers. The journals (psychology) distribution as per the Bradford's law revealed the ratio as 17:46:358, dispersion of journal titles did not satisfy the Bradford's Law of scattering, whereas this law suited well in the journals of social sciences. Gawande and Choukhande (2013) and Mishra and Gawde (2014) who studied citation analysis of doctoral theses of LIS and English submitted to Sant Gadge Baba Amravati University (1983-2010) and Vikram University, Ujjain (1975-2007) respectively found that journals are the most preferred documents by the research scholars followed by books in LIS, whereas books dominated in English with 80.47% citations. Single author is cited most in both the subjects. "ILA Bulletin" found the first rank receiving 67 citations in the subject of LIS, whereas "Tri Quarterly" is on the highest rank in English. Similar, citation study of doctoral works accepted at the Department of Agricultural Economics and Extension, Federal University of Technology Akure, Nigeria and the Faculty of Agronomy at the Central University of Venezuela has been carried out by Fasae (2012). The study revealed that nearly one-third of total citations were made to journal articles (34.97%), followed by citations to books having (25.15%) and the least came from web resources (1.49%) in the subject of Agricultural Economics and Extension,



whereas there was predominance of references (56.8%) to journal articles in Agricultural Science. Out of 4227 citations, 475 (11.24%) were below the period of 5 years and classified as very recent, while the highest 1902(45%) citations fall between 16 years and above and classified as not recent in Agricultural Economics and Extension, whereas the half-life of the citations in Agricultural Science Ph.D. theses was 11years, while the Price's index came to be (22%).The two journals most intensely cited by the researchers were Journal of Agricultural Economics and American Journal of Agricultural Economics in the field of Agricultural Economics and Extension, whereas Phytopathology and Agronomia Tropical journals topped the list of the most cited journals in Agricultural Science.

### 3. Objectives

The present study intends to find out the following key objectives:

- 3.1 To identify the bibliographic forms preferred by the agricultural scientists in the field of entomology
- 3.2 To find out the authorship pattern and degree of collaboration
- 3.3 To identify the subject-wise and year-wise distribution of cited journals
- 3.3 To identify the country-wise distribution of the cited journals
- 3.4 To prepare a ranked list of highly cited journals in the subject of entomology ,and
- 3.5 To examine the applicability of Bradford's Law of Scattering to the pattern of journals used by the researchers in entomology.

### 4. Hypothesis

For the present investigation, the hypothesis will be tested for the following statements:

- H<sub>1</sub>: The journals are the most preferred among the agriculture scholars in comparison to other forms of documents.
- H<sub>2</sub>: The tendency of research scholars is to cite Indian journals.
- H<sub>3</sub>: The agricultural scholars have a tendency to cite latest literature relevant to their field
- H<sub>4</sub>: Collaborative authorship is higher as compared to single authorship.
- H<sub>5</sub>: The citation data satisfies the Bradford's Law of Scattering.

### 5. Scope

The bibliographic references appended at the end of doctoral dissertations in the field of entomology have been taken as the source data for the present study. The doctoral dissertations awarded during the period 2010-2014 were taken into consideration pertaining to two State Agricultural Universities of North India: Punjab Agricultural University, Ludhiana (PAU); and Chaudhary Sarwan Kumar Himachal Pradesh KrishiVishvavidyala (CSKHPKV), Palampur.

### 6. Limitations

Following are the limitations of the present study:

- 6.1 Study delimited to only the citations data exclusively found in the Ph. D. theses of entomology.
- 6.2 Doctoral theses in entomology, submitted to the universities under study.
- 6.3 If the same reference is repeated using 'ibid' or 'op. cit.', it has been counted separately.
- 6.4 Only journal was considered for further analysis of the study, not any other bibliographic forms.

## 7. Methodology

Data for the present study consists of a total of 3387(1611+1776) citations appended to a total of 17 doctoral theses, i.e.10 from the Department of Entomology of Punjab Agricultural University, Ludhiana (PAU) and 7 from Chaudhary Sarwan Kumar Himachal Pradesh KrishiVishvavidyala, (CSKHPKV), Palampur for the period of 2010-2014. The method of data collection was the data extraction through citation analysis. Citations have been noted from the reference sections of each of the thesis on a standard size cards i.e. 5"x3" and collected data were arranged by using the MS-Excel worksheets. Analysis and interpretation has been carried out with the help of tables and graphs.

## 8. Data Analysis and Interpretation

Table-1  
Citations counts according to Bibliographic Forms

Bibliographic Forms	PAU				CSKHPKV			
	No. of Citations	% of Citations	Cumulative Citations	% of Cuulative Citations	No. of Citations	% of Citations	Cumulative Citations	% of Cumulative Citations
Journals	1139	70.70	1139	70.70	1304	73.42	1304	73.42
Books(Text/Ref)	111	6.89	1250	77.59	147	8.27	1451	81.70
Conference Proceedings/ Seminars	89	5.52	1339	83.11	105	5.91	1556	87.61
Theses & Dissertations	31	1.92	1370	85.04	40	2.25	1596	89.86
Govt./ Institutional Publications	78	4.84	1448	89.88	37	2.08	1633	91.94
Bulletins (Technical/ Research)	26	1.61	1474	91.49	25	1.40	1658	93.35
Report (Ann./Tec)	53	3.28	1527	94.78	19	1.06	1677	94.96
Newsletters	6	0.37	1533	95.11	25	1.40	1702	95.83
Manuals	8	0.49	1541	95.65	7	0.39	1709	96.22
Websites	25	1.55	1566	97.20	8	0.45	1717	96.67
Reference Sources	7	0.43	1573	97.64	6	0.33	1723	97.01
Others	21	1.30	1594	98.94	25	1.40	1748	98.42
Not identified	17	1.05	1611	100.00	28	1.57	1776	100.00
Total	1611	100.00	1611	100.00	1776	100.00	1776	100.00

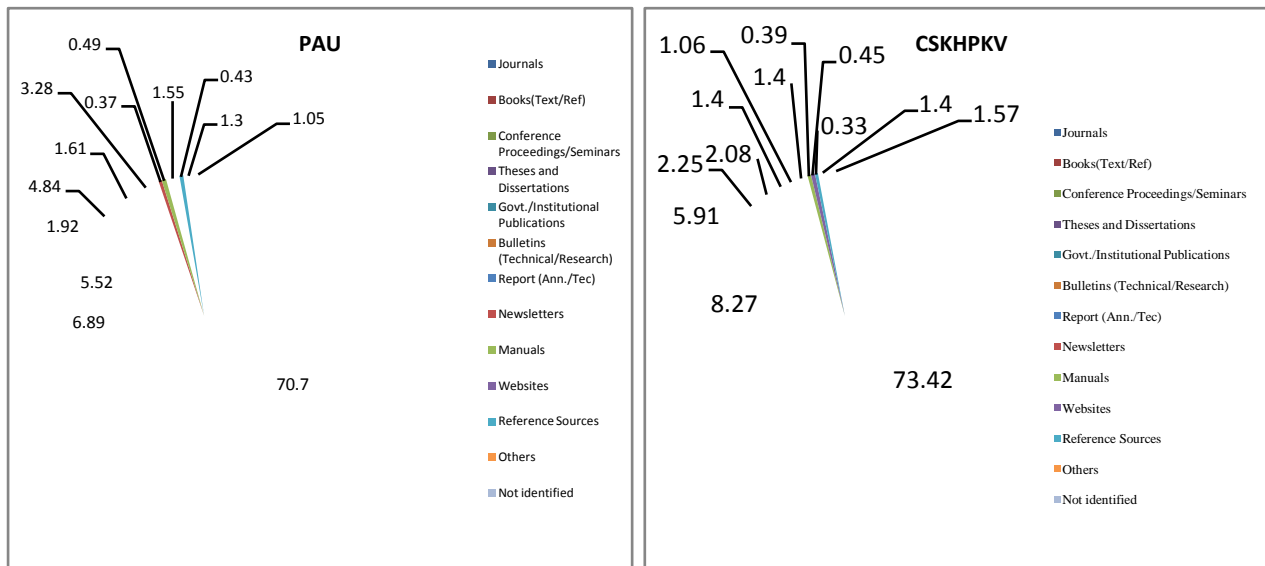


Fig.1 Bibliographic forms

Table 1 and Fig.1 reveal that journals are the most cited sources of information used by the agricultural scientists of PAU and CSKHPKV followed by Books and Conference /Seminar Proceedings. Journals account for the highest contributions, i.e. 1139 (70.70%) and 1304(73.42%) at PAU and CSKHPKV respectively. Books have 111(6.89%) and 147(8.27%) of the citations followed by Conference /Seminar Proceedings with 89(5.52%) and 105(5.91%) citations in the subject of Entomology in both the universities. Citations to Newsletters and Reference Sources are the least cited source of information at both the universities, i.e. 6(0.37%) at PAU and 6(0.33%) of the citations at CSKHPKV. Study clearly found that Journals, Books and Conference /Seminar proceedings are the most widely used sources of information in the field of entomology for the agricultural scientists of both the universities.

Table 2

Authorship Pattern of Cited Journals

Authors	PAU		CSKHPKV	
	No. of Citations	% of Citations	No. of Citations	% of Citations
Single Author	155	13.60	190	14.57
Two Authors	364	31.95	410	31.44
Three Authors	265	23.26	312	23.92
Four Authors	170	14.92	187	14.34
Five Authors	95	8.34	107	8.20
More than five Authors	90	7.90	98	7.51
Total	1139	100.00	1304	100.00



Fig. 2 Authorship Pattern

Table 2 and Fig. 2 show the authorship pattern of journal citations. It reveals that out of the total cited journals in the subject of Entomology, 1139 and 1304 journal citations were cited by the researchers of PAU and CSKHPKV, respectively. Two/three authors contributions with 410 (31.44%) and 312 (23.92%) were cited by the majority of the scientists of CSKHPKV as compared to PAU with 364(31.95%) and 265(23.26%) citations.

Table 3  
 Subject-Wise Distribution of Cited Journals

Subjects	PAU				CSKHPKV			
	No. of Citations	% of Citations	Cum. Citations	% of Cum. Citations	No. of Citations	% of Citations	Cum. Citations	% of Cum. Citations
Agricultural Science	260	22.82	260	22.82	315	24.15	315	24.15
Plant Protection	589	51.71	849	74.53	508	38.95	823	63.11
Environmental Science	116	10.18	965	84.72	73	5.59	896	68.71
Life Science	29	2.54	994	87.26	110	8.43	1006	77.14
Chemistry	18	1.58	1012	88.84	30	2.30	1036	79.44
Botany	53	4.65	1065	93.50	19	1.45	1055	80.90
Microbiology	17	1.49	1082	94.99	96	7.36	1151	88.26
Biotechnology	4	0.35	1086	95.34	7	0.53	1158	88.80
Horticulture Science	7	0.61	1093	95.96	44	3.37	1202	92.17
Medical Science	4	0.35	1097	96.31	6	0.46	1208	92.63
Science & Technology	17	1.49	1114	97.80	38	2.91	1246	95.54
Pharmaceutical Science	3	0.26	1117	98.06	3	0.23	1249	95.77
Plant-Breeding & Genetics	12	1.05	1129	99.12	33	2.53	1282	98.30
Food Science	-	-	-	-	6	0.46	1288	98.76

Multidisciplinary	10	0.87	1139	100.00	16	1.22	1304	100.00
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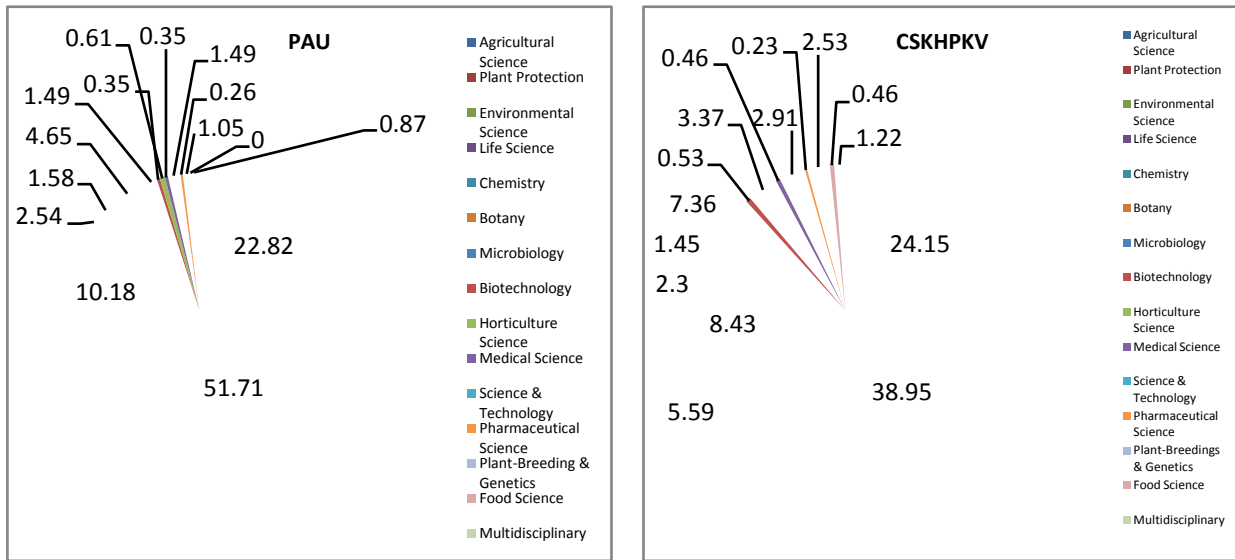


Fig.3 Subject-wise Distribution

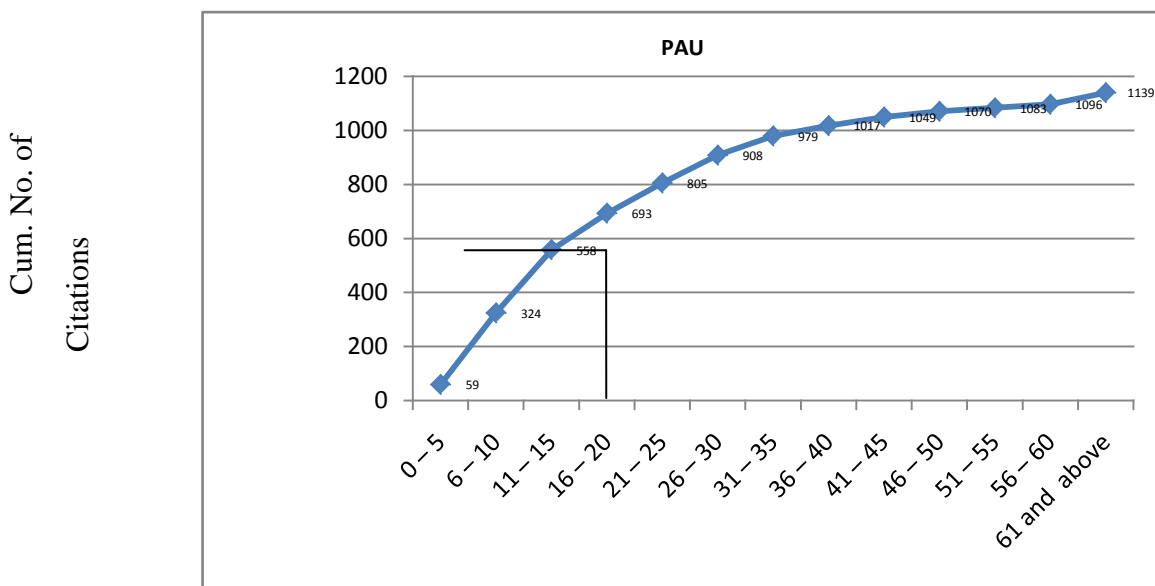
Table 3 reveals that the agricultural scientists of PAU gave first priority to the subject of Plant Protection with 589(51.71%), followed by Agricultural Science with 260(22.82%) and Environmental Science i.e.116 (10.18%). Plant Protection is the first choice of the researchers of CSKHPKV but with less citations i.e.508 (38.95%) as compared to PAU, followed by Agricultural Science with 315(24.15%) citations, which is maximum than PAU, Life Science is the third preference given by the agricultural scientists at CSKHPKV with 110(8.43%)

Table 4

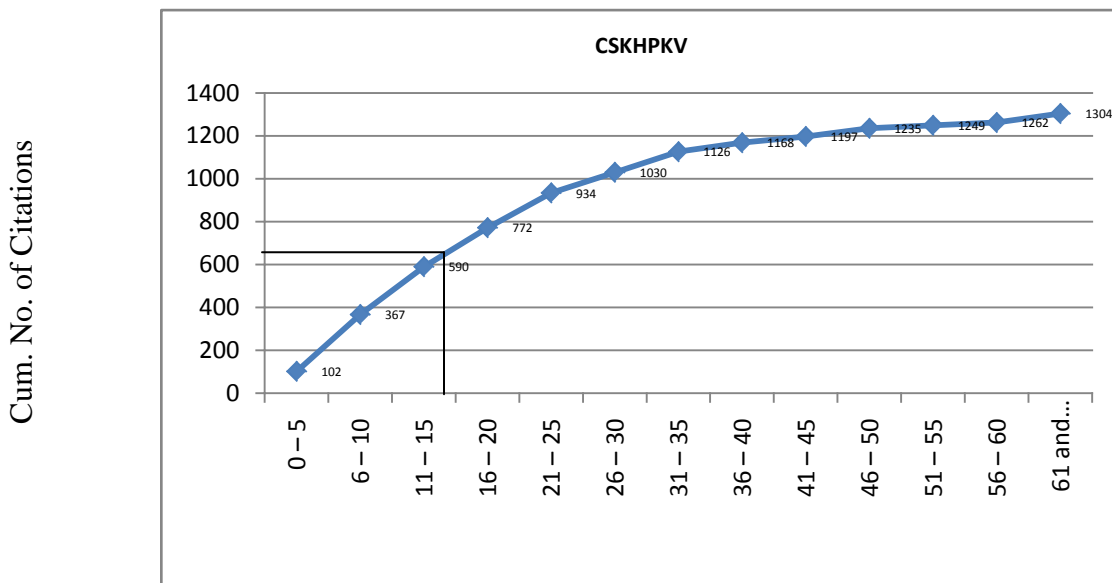
Chronological Distribution of Cited Journals

Age of Citations	PAU				CSKHPKV			
	No. of Citations	% of Citations	Cum. Citations	% of Cum. Citations	No. of Citations	% of Citations	Cum. citations	% of cum. citations
0 – 5	59	5.17	59	5.17	102	7.82	102	7.82
6 – 10	265	23.26	324	28.44	265	20.32	367	28.14
11 – 15	234	20.54	558	48.99	223	17.10	590	45.24
16 – 20	135	11.85	693	60.84	182	13.95	772	59.20
21 – 25	112	9.83	805	70.67	162	12.42	934	71.62
26 – 30	103	9.04	908	79.71	96	7.36	1030	78.98
31 – 35	71	6.23	979	85.95	96	7.36	1126	86.34
36 – 40	38	3.33	1017	89.28	42	3.22	1168	89.57
41 – 45	32	2.80	1049	92.09	29	2.22	1197	91.97
46 – 50	21	1.84	1070	93.94	38	2.91	1235	94.70
51 – 55	13	1.14	1083	95.08	14	1.07	1249	95.78
56 – 60	13	1.14	1096	96.22	13	0.99	1262	96.77
61 and above	43	3.77	1139	100.00	42	3.22	1304	100.00
Total	1139	100.00	1139	100.00	1304	100.00	1304	100.00





Year-wise Distribution  
Fig.4 Obsolescence of Entomology Literature



Year-wise Distribution  
Fig. 4(a) Obsolescence of Entomology Literature

Table-4 indicates year-wise distribution of the cited journals. More than 60 years old journals have been used by the agricultural scientists in the field of Entomology which shows the wider time span of research findings approach of the scientists in this area. Near about 60% of the articles in both the universities, i.e. PAU and CSKHPKV are 12 years old. 23.26% of the citations in PAU and 20.32% in CSKHPKV range between 11-15 years.





To find the half-life of Entomology at both the universities, plain graphs are drawn taking the cumulative number of citations on the X-axis and year-wise distribution on the Y-axis as presented in fig.4 and 4(a). A line parallel to X-axis is drawn in both figures from the point A (A represent half of the total citations i.e. 569 and 652) to reach the curve at the point B. From B another line parallel to Y-axis is drawn to reach the X-axis at point C. The half-life of Entomology literature at PAU and CSKHPKV, as represent by OC is found to be 11-15 years.



Table 5  
Country- wise Distribution of Cited Journals

Country	PAU				Country	CSKHPKV			
	No. of Citations	% of Citations	Cumulative Citations	% of Cumulative Citations		No. of Citations	% of Citations	Cumulative Citations	% of cumulative citations
USA	321	28.18	321	28.18	India	418	32.05	418	32.05
India	315	27.65	636	55.83	USA	375	28.75	793	60.81
UK	190	16.68	826	72.51	UK	175	13.42	968	74.23
Netherlands	85	7.46	911	79.98	Netherlands	58	4.44	1026	78.68
Japan	41	3.59	952	83.58	Pakistan	37	2.83	1063	81.51
Pakistan	35	3.07	987	86.66	Germany	28	2.14	1091	83.66
China	20	1.75	1007	88.41	Japan	27	2.07	1118	85.73
Germany	16	1.40	1023	89.81	China	25	1.91	1143	87.65
Canada	15	1.31	1038	91.13	Brazil	17	1.30	1160	88.95
Australia	12	1.05	1050	92.18	Australia	13	0.99	1173	89.95
Brazil	11	0.96	1061	93.15	Turkey	11	0.84	1184	90.79
Kenya	10	0.87	1071	94.02	Canada	10	0.76	1194	91.56
NewZealand	6	0.52	1077	94.55	Korea	10	0.76	1204	92.33
Czech.Rep.	6	0.52	1083	95.08	Nigeria	10	0.76	1214	93.09
Nigeria	5	0.43	1088	95.52	France	9	0.69	1223	93.78
France	5	0.43	1093	95.96	Egypt	9	0.69	1232	94.47
-	-	-	-	-	Italy	7	0.53	1239	95.01
-	-	-	-	-	Poland	7	0.53	1246	95.55
-	-	-	-	-	Colombia	5	0.38	1251	95.93



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Others having less than 5 citations	46	4.03	1139	100.00	Others having less than 5 citations	53	4.06	1304	100.00
Total	1139	100.00	1139	100.00	Total	1304	100.00	1304	100.00

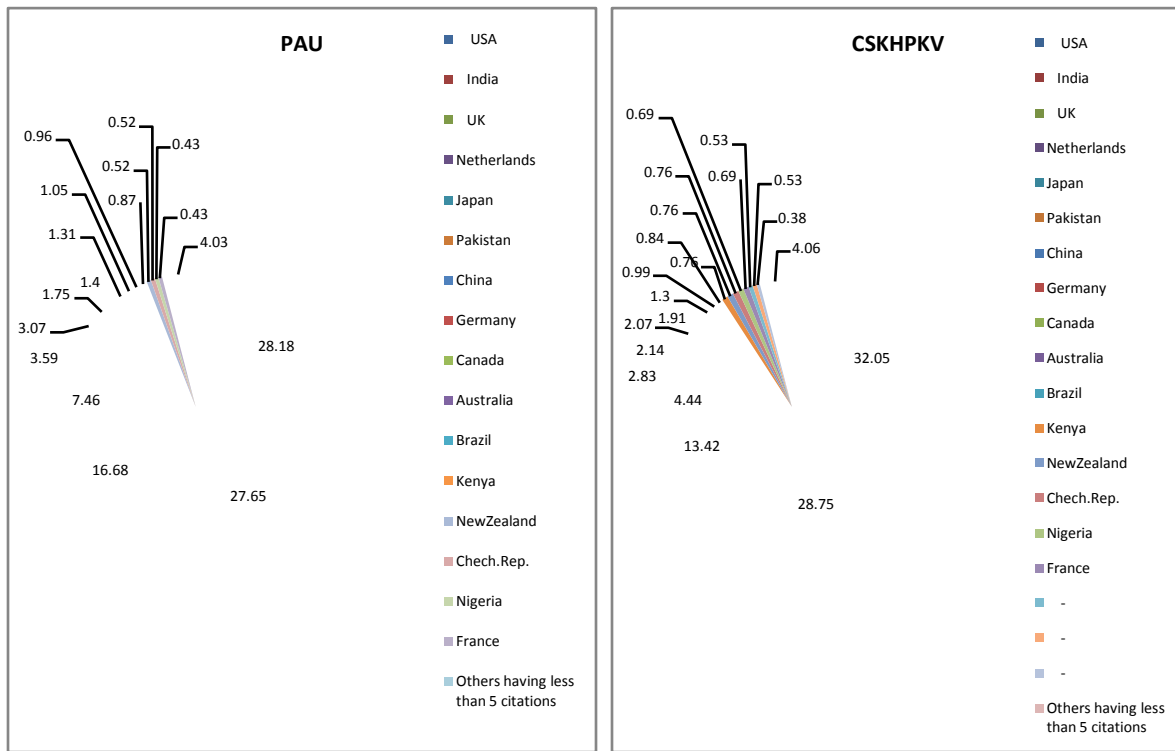


Fig. 5 : Country-wise Distribution

Table 5 clearly indicates that majority of articles with 321 (28.18%) were contributed from USA in the subject of entomology, followed by India with 315(27.65%) and UK with 190(16.68%) articles at PAU, respectively. India topped the list with 418 (32.05%) followed by USA and UK with 375 (28.75%) and 175 (13.42%) citations at CSKHPKV. France’s contribution is minimal with 9(0.69%) citations at CSKHPKV and PAU with 5(0.43%) only. It was observed that (81.49%) citations of the total were contributed altogether from USA, India, Netherlands, UK, Pakistan and Japan at PAU and CSKHPKV in the field of entomology.



Table 6 (a)

## Ranking of Cited Journals in Entomology (PAU)

Sr. No.	Title of Journal	Rank	No. of Citations	% of Citations	Cumulative Citations	% of Cumulative Citations
1	Journal of Economic Entomology	1	59	5.17	59	5.17
2	Indian Journal of Entomology	2	48	4.21	107	9.39
3	Journal of Insect Science	3	31	2.72	138	12.11
4	Journal of Entomology Research	4	29	2.54	167	14.66
5	Bulletin of Entomology Research	5	28	2.45	195	17.12
6	Pesticide Research Journal	5	28	2.45	223	19.57
7	Indian Journal of Agricultural Research	6	26	2.28	249	21.86
8	Annual Review of Entomology	7	24	2.10	273	23.96
9	Journal of Agriculture Food Chemistry	8	22	1.93	295	25.89
10	Pestology	8	22	1.93	317	27.83
11	Environmental Entomology	9	21	1.84	338	29.67
12	Entomology Exp. Application	10	18	1.58	356	31.25
13	Indian Journal of Plant Protection	10	18	1.58	374	32.83
14	Annals of Plant Protection Science	10	18	1.58	392	34.41
15	Crop Protection	10	18	1.58	410	35.99
16	Pesticide Science	10	18	1.58	428	37.57
17	Bull. Environment Contaminated Toxic	11	17	1.49	445	39.06
18	Biodegradation	12	16	1.40	461	40.47
19	Journal of Environment Health Part-B	13	13	1.14	474	41.61
20	Indian Journal of Ecology	14	12	1.05	486	42.66
21	Bull. Br. Must. Nat. Hist. Zoo	14	12	1.05	498	43.72
22	Applied Entomology and Zoology	15	11	0.96	509	44.68
23	Pest Management Science	15	11	0.96	520	45.65
24	Journal of Applied	16	10	0.87	530	46.53



	Entomology					
25	Insect Science Application	16	10	0.87	540	47.41
26	Chemosphere	16	10	0.87	550	48.28
27	Pesticide Biochem.Physiology	17	9	0.79	559	49.07
28	Canadian Entomology	17	9	0.79	568	49.86
29	Journal of Chem.Entomology	18	8	0.70	576	50.57
30	Current Science	18	8	0.70	584	51.27
31	Annals of the Entomological Society of America	18	8	0.70	592	51.97
32	Journal of Biological Control	18	8	0.70	600	52.67
33	Journal of Environmental Quality	19	7	0.61	607	53.29
34	Phytoparasitica	19	7	0.61	614	53.90
35	Journal of Maharastra AgriculturalUniversity	19	7	0.61	621	54.52
36	Journal of Research Punjab Agri.Uni.	19	7	0.61	628	55.13
37	Annals of Applied Biology	20	6	0.52	634	55.66
38	Journal of Pesticide Science	20	6	0.52	640	56.18
39	Shaspa	20	6	0.52	646	56.71
40	Pakistan Entomology	20	6	0.52	652	57.24
41	International Journal of Agric. Research	20	6	0.52	658	57.76
42	Applied Microbiology & Biotechnology	20	6	0.52	664	58.29
43	Nature	20	6	0.52	670	58.82
44	Agric. Ecosystem Environment	20	6	0.52	676	59.35
45	Tropical Pest Management	21	5	0.43	681	59.78
46	Entomology	21	5	0.43	686	60.22
47	European Journal of Entomology	21	5	0.43	691	60.66
48	Physiology of Entomology	21	5	0.43	696	61.10
49	Journal of Applied Ecology	21	5	0.43	701	61.54
50	Indian Journal of Pulses Research	21	5	0.43	706	61.98
51	South-West Entomology	21	5	0.43	711	62.42
52	Environment Toxic. Chemistry	21	5	0.43	716	62.86
53	Biological Control	21	5	0.43	721	63.30
54	Madras Agric. Journal	21	5	0.43	726	63.74
55	Journal of Bio pesticide	21	5	0.43	731	64.17
56-68	13 Journals having 4 citations	22	52	4.56	783	68.74



69-80	12 Journals having 3 citations	23	36	3.16	819	71.90
81-140	56 Journals having 2 citations	24	112	9.83	931	81.73
141-358	208 Journals having 1 citation	25	208	18.26	1139	100.00

Table 6 (b)

## Ranking of Cited Journals in Entomology (CSKHPKV)

Sr. No.	Title of Journal	Rank	No. of Citations	% of Citations	Cumulative Citations	% of Cumulative Citations
1	Indian Journal of Entomology	1	88	6.74	88	6.74
2	Journal of Invertebrate Pathology	2	69	5.29	157	12.03
3	Journal of Economic Entomology	3	57	4.37	214	16.41
4	Applied Environmental Microbiology	4	27	2.07	241	18.48
5	Journal of Insect Science	5	25	1.91	266	20.39
6	Environmental Entomology	6	24	1.84	290	22.23
7	Indian Journal of Agricultural Science	7	21	1.61	311	23.84
8	Annual Review of Entomology	8	19	1.45	330	25.30
9	Pest Management & Economic Zoology	9	18	1.38	348	26.68
10	Bio control Science & Technology	10	17	1.30	365	27.99
11	Journal of Nematology	11	16	1.22	381	29.21
12	Indian Journal of Nematology	12	15	1.15	396	30.36
13	Indian Journal of Plant Protection	13	14	1.07	410	31.44
14	Insect Environment	13	14	1.07	424	32.51
15	Journal of Entomological Research	14	13	0.99	437	33.51
16	Journal of Soil Biology & Ecology	14	13	0.99	450	34.50
17	Annals of Plant Protection Science	15	12	0.92	462	35.42
18	Applied Entomology & Zoology	16	11	0.84	473	36.27
19	Crop Protection	16	11	0.84	484	37.11
20	Biological Control	16	11	0.84	495	37.96
21	Bulletin of Entomological	17	10	0.76	505	38.72





	Research					
22	Journal of Bio-pesticides	17	10	0.76	515	39.49
23	Journal of Biological Control	17	10	0.76	525	40.26
24	Karnataka Journal of Agric. Sciences	18	9	0.69	534	40.95
25	Pest Management in Horticultural Ecosystems	18	9	0.69	543	41.64
26	Journal of the Indian Potato Association	18	9	0.69	552	42.33
27	Nematologica	18	9	0.69	561	43.02
28	Entomon.	19	8	0.61	569	43.63
29	Pesticides	19	8	0.61	577	44.24
30	Current Microbiology	19	8	0.61	585	44.86
31	Nature	19	8	0.61	593	45.47
32	Current Science	20	7	0.53	600	46.01
33	Journal of Chromatography	20	7	0.53	607	46.54
34	Entomophaga	20	7	0.53	614	47.08
35	Nematology	20	7	0.53	621	47.62
36	Tropical Pest Management	21	6	0.46	627	48.08
37	Progressive Horticulture	21	6	0.46	633	48.54
38	Journal of Chemical Ecology	21	6	0.46	639	40.00
39	Korean Journal of Applied Nematology	21	6	0.46	645	49.46
40	Fundamental & Applied Nematology	21	6	0.46	651	49.92
41	Mycological Research	21	6	0.46	657	50.38
42	Nucleic Acid Research	21	6	0.46	663	50.84
43	Molecular Ecology	21	6	0.46	669	51.30
44	Annals of the Entom. Society of America	21	6	0.46	675	51.76
45	Archives of Phytopathology & Plant Protection	22	5	0.38	680	52.14
46	African Journal of Biotechnology	22	5	0.38	685	52.53
47	Journal of Applied Microbiology	22	5	0.38	690	52.91
48	Molecular Ecology & Evolution	22	5	0.38	695	53.29
49	Science	22	5	0.38	700	53.68
50	Mycologia	22	5	0.38	705	54.06
51-72	22 Journals having 4 citations	23	88	6.74	793	60.81



73-106	33 Journals having 3 citations	24	99	7.59	892	68.40
107-173	66 Journals having 2 citations	25	132	10.12	1024	78.52
174-454	280 Journals having 1 citation	26	280	21.47	1304	100.00

Tables 6(a) and (b) depicts the ranked list of most used cited journals in the field of Entomology. It is found that the researchers in Entomology have cited a total of 358 journals in PAU and 454 journals in CSKHPKV. *Journal of Economic Entomology* occupies the first rank with (5.17%) of the cited journals, followed by *Indian Journal of Entomology* with (4.2%) in PAU whereas *Indian Journal of Entomology* occupies the first rank with (6.74%), and followed by *Journal of Invertebrate Pathology* with (5.29%) of the total cited journals in CSKHPKV. The first 13 journals covers (32.83%) of the total cited journals whereas in CSKHPKV the first 14 journals covers almost equal (32.51%) citations of the total cited journals.

Table 7

## Scattering of Journals and Citations over Bradford's Zone in Entomology

Zone	PAU				CSKHPKV			
	No. of Journals	% of Journals	No. of Citations	% of Citations	No. of Journals	% of Journals	No. of Citations	% of Citations
1	13	1.58	374	32.83	15	1.15	437	33.51
2	42	3.68	357	31.34	91	6.97	455	34.89
3	303	26.60	408	35.82	348	26.68	412	31.59

It is clear from the above table that in PAU, the first 13 journals cover 374 articles, next 42 journals cover 357 articles and the last 303 journals cover 408 articles. In other words, approximately one-third of the total citations have been covered by each group of journals. Based on the Bradford law, each zone should follow a linear geometric expression in the form of  $1 : n : n^2$ . On analysis of the data, it is found that the literature on Entomology does not follow this rule and each zone represents the Bradford expression as

$$13:42:303 = 13: 13 \times 3: 13 \times 9^2 \\ = 13: 39:1053$$

This doesn't fit well into the Bradford's distribution where as in CSKHPKV, the first 15 journals cover 437 articles, and next 91 journals cover 455 articles and the last 348 journals cover 412 articles only. The Bradford's Law of Scattering also doesn't fit well into the distribution, for example:

$$15:91:348 = 15: 15 \times 3: 15 \times 9^2$$



= 15: 45: 1215

It has been found that in both the Agricultural Universities of North India i.e. PAU and CSKHPKV, the Bradford's Law of Scattering does not suit well into the distribution of the journals.

## 9. Findings

The major findings of the present study are as under:

- Agricultural Scientists are mainly using journal articles with 1139(70.70%) citations in PAU and 1304(73.42%) citations in CSKHPKV.
- Two authored articles with (31.95%) in PAU and (31.44%) citations in CSKHPKV dominated the authorship pattern for journals followed by three authors i.e. (23.26%) in PAU and (23.92%) citations in CSKHPKV.
- Plant Protection is the first choice, as a subject by the researchers in both PAU and CSKHPKV with 589(51.71%) and 508(38.95%) followed by Agricultural Science.
- Majority of the agricultural scientists cited the latest journals i.e. (23.26%) in PAU and (20.32%) in CSKHPKV published in the years ranging from 2005-2009.
- Citations of journals, *Indian Journal of Economic Entomology* occupied the first rank with 59(5.17%) citations in PAU and *Indian Journal of Entomology* with 88(6.74%) citations in CSKHPKV.
- The most of the journals cited by the agricultural scientists of PAU were from USA with 321(28.18%) followed by India with 315(27.65%) in PAU and India with 418(32.05%) citations topped the list, followed by USA with 375(28.75%) in CSKHPKV.
- Bradford's law does not fit well in the journals cited in the field of entomology both at PAU and CSKHPKV.

## 10. Test of Hypothesis

In the beginning of the research few hypothesis have been formulated. They have been tested with the statistical analysis. The data has been collected and analyzed from 17 Ph.D. theses submitted in PAU, Ludhiana and CSKHPKV, Palampur during the period of 2010-2014 in the field of Entomology.

### Hypothesis-1: Journals are the most preferred source of information

The study reveals that in the agricultural scientists are mostly using journals with 1139(70.70%) citations in PAU and 1304(73.42%) citations in CSKHPKV. It clearly reflects that journals are the most preferred source of information, so the hypothesis also proved to be true.

### Hypothesis-2: Indian Journals are the most cited journals

The statistical study reveals that Indian journals are the most cited journals by the agricultural scientists in CSKHPKV with 418(32.05%) citations, but in PAU, journals that dominate the list are from USA with 321(28.18%) citations. So this hypothesis proved to be half true.

**Hypothesis-3: Latest literature is given importance by the researchers**

The result reveals that the agricultural scientists have given greater emphasis on citing the latest journals i.e. (23.26%) in PAU and (20.32%) in CSKHPKV published in the years ranging from 2005-2009. So this hypothesis proved to be true.

**Hypothesis-4: Collaborative Authorship is high in Entomology**

In the field of Entomology, citations of two authorship were dominated in both the universities with (31.95%) and (31.44%) respectively. So this hypothesis also proved to be true.

**Hypothesis-5: Citation data in Entomology satisfies the Bradford's Law of Scattering**

The result shows that the Bradford's Law of Scattering does not fit well into the distribution of the journals. So, this hypothesis proved not to be true.

**11 Conclusion**

The present paper has been undertaken to trace out the development of Entomology research at the Ph.D. level for the five years i.e. 2010-2014 of PAU and CSKHPKV. The study indicates that the agricultural scientists consult different sources of information for their research purpose but scientific journals have been given first preference by them for obtaining specific information and keeping themselves up-to-date. Two authored articles dominate the authorship pattern of the cited journals at both the Universities. *Indian Journal of Economic Entomology* and *Indian Journal of Entomology* have been ranked first in the list of core journals. The subject 'Plant Protection' is the first choice of the agricultural scientists as compare to the other subjects. In case of geographical contribution, the study revealed that the USA and India are the highest contributors of citations at PAU and CSKHPKV.

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