

## Scientometric Portrait of Hari Chand Sharma: A Renowned Agricultural Scientist

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### ABSTRACT

An analysis of 595 documents produced by Dr Hari Chand Sharma indicates that about 45 per cent of these were published as journal articles. Most of the research papers were published in journals originating from the UK, the USA and the Netherlands in medium impact factor journals. He has produced majority of his publications in collaboration with other scientists and had collaborated with more than 1,000 authors as indicated by high value of collaboration coefficient (0.66) and collaboration rate of 1.00 for considerable number of years. He was most productive during the age of 58-60 year. The high value of citations per paper indicated that the research outputs of Dr Sharma were part of the main stream science.

**Keywords:** Scientometric portrait; H.C. Sharma; Agricultural scientist; India.

### 1. INTRODUCTION

Several terms like Information profile<sup>1</sup> or Micro-bibliometrics<sup>2</sup> or Bio-bibliometrics<sup>3</sup> have been used to describe the contributions an individual scientist, either living or dead, has made to a field of knowledge to discover and establish a functional relationship between his bio-data and bibliometric data elements. Kademani<sup>4,5</sup>, *et al.* were the first to suggest that “Scientometric portrait” is most appropriate phrase to carryout bio-bibliometric studies on scientists. In the recent past, several studies dealing with Scientometric portrait of Nobel Laureates and other eminent scientists in different disciplines have been reported in literature. These studies have basically analysed the publication productivity, pattern of collaboration, their areas of research, and the journals used for publishing research results. Some of these studies have been described in the following paragraph.

For instance, Gupta<sup>6</sup> examined citations of 401 papers of S. Chandrasekhar, who shared the 1983 Nobel Prize for physics with William A. Fowler. The study found a high correlation between quantity and quality based on citations and honors and awards. Kademani<sup>7</sup>, *et al.* examined the domains, authorship pattern, publication productivity and scattering of publications of Dorothy Crowfoot Hodgkin, the Nobel Prize winner in Chemistry in 1964. In another study, Kademani<sup>8</sup>, *et al.* developed a Scientometric portrait of Sir C.V. Raman, the Noble Prize winner in Physics in 1930 for scattering of light. Kalyane and Sen<sup>9</sup> made an analysis of 422 paper published during 1956 to 1995 by the Nobel laureate Pierre-Gilles de

Genes, a French physicist. Authors found that the productivity of the scientist peaked in his 40's and his journal preference showed a distinct national bias. Munnolli<sup>10</sup> made an analysis of the publication productivity of Harald zur Hausen, who was honoured with Nobel Prize for his discovery of *Human Papilloma virus* causing cervical cancer. In addition to these studies of Noble laureates, several other authors developed the Scientometric portrait of other eminent scientists from India and abroad. Kalyane and Sen<sup>11</sup> analysed the contributions of Professor Tibor Braun, eminent analytical chemists and a Scientometrician of world repute and the founder editor of the international journal “Scientometrics”. Munnolli and Kalyane<sup>12</sup> analysed 312 paper published by Ram Gopal Rastogi published during 1954 to 1992 in various domains of astrophysics. The core journals preferred by him for publishing the papers were Indian Journal of Radio & Space Physics, Journal of Atomic & Terrestrial Physics, and Proceedings of the Indian Academy of Sciences. Bhaskar<sup>13</sup> analysed 222 article indexed in the Web of Science and Scopus authored by Professor Lalji Singh, an eminent Indian scientist in the field of genome analysis and DNA Fingerprinting. Most of the articles were published when he served at the Centre for Cellular and Molecular Biology, Hyderabad, during 1987-2011. Almost all his articles appeared in high-impact journals. The present study examines the publication productivity and the impact of research output of Dr Hari Chand Sharma (Later to be named as Dr Sharma), a renowned agricultural scientist for the 269 papers published in journals between 1976-2016. Similar studies can be undertaken by other library and informational professionals to develop a scientometric portrait of other individual scientists using the present study and the studies quoted in it.

## 2. HARI CHAND SHARMA

Dr H.C. Sharma was born on 15<sup>th</sup> June 1954 at Behra, in district Bilaspur, Himachal Pradesh, India. He was the gold medalist for his Bachelor and Masters degree in Agricultural sciences with specialisation in Entomology in 1976 from College of Agriculture, Solan, under the jurisdiction of Y.S. Parmar University of Horticulture and Forestry (Himachal Pradesh), of which he is at present, the Vice Chancellor. He completed his doctoral degree in the year 1979 from the ICAR-Indian Institute of Agricultural Sciences, New Delhi. He pursued his post-doctoral studies at the University of Wisconsin, Madison, Wisconsin, USA, and also served as a visiting scientist at the Queensland Department of Primary Industries, Toowoomba, Australia. His research interests are in the areas of insect bio-ecology, insect-resistant cultivars, mechanisms and inheritance of resistance, molecular markers and transgenics for insect resistance, tri-tropic interactions, bio-safety of transgenic crops to the environment, climate change effects on arthropods and integrated pest management for sustainable crop production and food security. He has worked at ICAR-Central Institute for Cotton Research, Nagpur, Maharashtra, and at the International Crops Research Institute for the Semi-Arid tropics (ICRISAT) at Hyderabad, Andhra Pradesh, India for nearly 37 year. He has also worked as a Visiting Scientist at the University of Wisconsin, Madison, USA, and Department of Primary Industries, Queensland, Australia.

He has been conferred with several awards like the Lal Bahadur Shastri Memorial Gold Medal (B.Sc. Ag), Mohan Meakins Gold Medal (M.Sc.), Consultative Group on International Agricultural Research (CGIAR) outstanding scientist award, International Plant Protection Award of Distinction, Millennium ICRISAT Science Award, Doreen Mashler Award, Hari-Om Trust Award of ICAR, Bharat Jyoti Award and several others.

He has served as President of the Council of the International Congresses of Entomology, and Member – Governing Board, International Association of Plant Protection Sciences. He is a Member of AHTEG Committee of CBD – UNEP, and a Fellow of seven academies including Entomological Society of India, National Academy of Agricultural Sciences, and Entomological Society of America. He has supervised more than 35 PhD scholars and more than 10 post-doctoral fellow or visiting scientists. He has widely travelled in Asia, Africa, Australia, Europe, and North and South America. He has authored over 595 publication described in detail under the results and analyses.

## 3. OBJECTIVES

Following are the objectives of the study.

- Type of documents generated by Dr Sharma during 1976-2016
- Determine the position of Dr Sharma as main author and as co-author
- Examine the chronological distribution of publication outputs
- Examine the publication output in relation to age and peak period of productivity
- Explore the authorship pattern and collaborative research

pattern of Dr Sharma to calculate the value of collaboration rate and collaboration coefficient

- Examine the relative performance of published work on the basis of papers in terms of publishing country of the journal and their impact factor
- Compare the research impact in terms of number of citations received, and identification of highly cited papers.

## 4. DATA SOURCE AND RESEARCH METHODOLOGY

The present study is based on the list of papers published by Dr H.C. Sharma, and made available by Dr Sharma to the authors of this paper. The data so obtained was analysed for the type of documents authored by Dr H.C. Sharma, pattern of authorship and collaboration, productivity by actual and publishing age, identification of journals used for dissemination of research results, their country of publication and impact factor. Citations of the published papers were identified using the Google Scholar database. Based on this, authors also identified highly cited papers which received 100 or more citations. The data was fed into an MS Excel data sheet for analysis to examine the objectives.

## 5. RESULTS AND ANALYSIS

During 1976-2016, Dr Sharma published 595 records on different aspects of agricultural sciences and its sub-disciplines. Of these 269 (45.2 %) were research articles in journals published from different parts of the globe, followed by poster presentations 153 (25.7 %). These two types of documents together constituted more than two-third (70.9 %) of the total output. The rest 29.1 per cent of the records were published as conference papers 59 (9.9 %), book chapters 57 (9.6 %), newsletter articles 16 (2.7 %), webpage articles and information bulletins each 12 (2.0 %), books 7 (1.2 %), plant material description and technical reports each 4 (1.3 %), and book reviews 2 respectively. Like other scientists quoted in the text of the paper, Dr Sharma also published highest number of records as journal articles. Following paragraphs describe in detail the other aspects of the study based on 269 paper published as journal articles.

## 6. PRODUCTIVITY

Dr Sharma published 269 journal articles during a period of 41 year (1976-2016). Thus, the productivity of Dr Sharma is 6.6 paper per year. The journals in which these papers were published originated from India and abroad. Data presented in Table 1 indicates that of the 269 papers published by Dr Sharma, only 11 (4.1 %) papers were single authored, and the rest authored in collaboration with two or more authors. A raw analysis of data indicates that Dr Sharma published three papers in the year 1976 at the age of 22 year (publishing age one) in collaboration with different authors. Of the three papers, two were published in Indian journals namely Indian Journal of Ecology and Himachal Journal of Agricultural Research and one in American Bee Journal. Further analysis of data presented in Table 1 indicates that he was most productive in the last two quinquenniums at the age of 52-62 year

**Table 1. Quinquennial publication productivity of Dr. H.C. Sharma during 1976-2016**

Quinquennium Number (Years)	Single authored paper	Multi authored Papers	Total papers	Collaboration Rate	Publishing Age	Actual Age
1 (1976-1980)	-	5	5	1.00	1-5	22-26
2 (1981-1985)	2	13	15	0.87	6-10	27-31
3 (1986-1990)	-	14	14	1.00	11-15	32-36
4 (1991-1995)	2	25	27	0.93	16-20	37-41
5 (1996-2000)	2	12	14	0.86	21-25	42-46
6 (2001-2005)	2	39	41	0.95	26-30	47-51
7 (2006-2010)	-	60	60	1.00	31-35	52-56
8 (2011-2016)*	2	90	92	0.98	36-41	57-62
Total	11	258	269	0.96		

\*2016 has been clubbed in the last Quinquennium, being a single year.

(publishing age between 31-41 years). Of the total 269 papers, he published more than half (56.5 %) of the papers in these two quinquenniums of 2006-2010 and 2011-2016. All these papers were produced in collaboration except two paper, which were single authored.

## 7. COLLABORATION RATE

Collaboration Rate (CR) is the ratio of the number of multi-authored papers published in a quinquennium to the total number of papers published in those quinquenniums. Based on this ratio, it has been observed that the value of CR for the entire period of 1976-2016 was 0.96, and equal to one during three quinquenniums of 1976-1980, 1986-1990 and 2006-2010. It was close to one during the quinquenniums of 2011-2016 and 2001-2005. It indicates that Dr Sharma preferred to work in a team rather than working as an individual. This is also indicated by the number of multi-authored and single authored papers he has published during the study period. He published only 11(4.1 %) papers as single authored papers, and rest all are multi-authored papers.

## 8. COLLABORATION COEFFICIENT

Collaboration Coefficient (CC) Ajiferuke, Burrell and Tague<sup>15</sup> suggested a single measure to measure collaborative research, and termed it as collaboration coefficient. The method is based on fractional productivity defined by Price and Beaver<sup>16</sup>. The formula used to calculate CC is explained as follows.

$$cc = 1 - \frac{\sum_{j=1}^k (1/j) f_j}{N}$$

where  $f_j$  is the number of  $j$  authored papers;  $N$  is the total number of research papers published, and  $k$  is the greatest number of authors per paper.

According to the authors, CC tends to zero as single authored papers dominate, and to  $1-1/j$  as  $j$ -authored papers dominate. This implies that higher the value of CC, higher

the probability of papers with multi or mega authors. The multi author papers have 3 or 4 authors; while mega authored papers have more than 4 authors. However, inclusion of authors as multi or mega can be changed according to nature of data available for analysis. Using the above formula, authors calculated the value of CC (as followed), which was found to be 0.66. Based on the value of CC, it can be concluded that the author has produced a large number of papers in collaboration with other scientists.

$$\begin{aligned} & 1/1*11 + 1/2*61 + 1/3*60 + 1/4*70 \\ & + 1/5*26 + 1/6*22 + 1/7*8 + 1/9*11 \\ & = 11 + 30.5 + 20 + 17.5 + 5.2 + 3.7 \\ & + 1.1 + 1.2 \\ & = 90.2/269 = 0.34 \\ & \text{Hence CC} = 1 - 0.34 = 0.66 \end{aligned}$$

## 9. AUTHORSHIP STATUS IN COLLABORATIVE PAPERS

The order of appearance of author names on a document is considered useful for determining their importance, as not all positions of author names have the same value. Data presented in Table 2 indicates that Dr Sharma collaborated with 1,007 authors to produce 269 paper. He was the primary author or first author in 109 (40.5 %) paper, and in the rest 160 (59.5 %) paper, he acted as a co-author. In the co-authored papers, he occupied second position in 82 (30.5%) papers. In the remaining papers, he occupied third position in 27 papers and in remaining 51 papers his position ranged from four to 12. This implies that Dr Sharma occupied first or second position in 71 per cent of the papers authored jointly by him. Based on this, one can say that Dr Sharma occupied prominent authorship position (either first or second) in significant number of papers.

## 10. COMMUNICATION PATTERN OF DR SHARMA

The communication pattern of Dr Sharma has been examined using two different indicators. These are the publishing country of journals where the research results were published, and the impact factor (IF) of these journals, which were obtained from Journal Citation Reports 2012. Journals published from the advanced countries in the West command more respect and main stream connectivity as compared to journals published from India or other developing countries. The impact factor is an indicator of the reputation of the journal. Papers published in journals with higher IF by and large indicate more credit than papers published in journals with low IF. The findings based on these two indicator have been described as follows.

### 10.1 Distribution of Papers According to Impact Factor

Based on the value of impact factor, impact factors have

**Table 2. Publication productivity of Dr H.C. Sharma**

Publications	Position of Harish Chandra Sharma							Total papers (Per cent)	Total authors (Per cent)
	I	II	III	IV	V	VI	VII		
Single authored papers	11							11 (4.1)	11 (1.1)
Two authored papers	42	19						61 (22.7)	122 (12.0)
Three authored papers	26	21	13					60 (22.3)	180 (17.7)
Four authored papers	20	22	10	18				70 (26.0)	280 (27.5)
Five authored papers	4	10	1	2	9			26 (9.7)	130 (12.8)
Six authored papers	4	6	-	1	4	7		22 (8.2)	132 (12.9)
Seven or more authored papers	2	4	3	2	4	2	2	19 (7.1)	163 (16.0)
Total	109	82	27	23	17	9	2	269	1018

(I = 1st author, II = 2nd author, III = 3rd author, IV = 4th author, V = 5th author, VI = 6th author and VII = 7th author).

been divided into four categories. These are  $\leq 1$  (low),  $> 1 \leq 3$  (medium),  $> 3 \leq 5$  (high) and  $> 5$  (very high). Distribution of output according to the range of impact factor as given in Table 3 indicates that more than one third (102) of the papers published by Dr Sharma have been published in journals with no impact factor. Of the remaining 167 paper, 31 (11.5 %) paper were published in low impact factor journals, which had an impact factor less than or equal to one. About 44.5 per cent papers have been published in medium impact factor journals, and the rest 6 per cent paper in high and very high impact factor journals. However, in general, journals publishing research in the field of agricultural sciences have low impact factor. Still half of the papers were published in journals with medium, high or very high impact factor journals. Further analysis of data indicates that the papers in high and very high impact factor journals were published during the period of 2002-2016. The age of Dr Sharma during this period varied between 48 year to 62 year. These papers received 500 citation in all. Of these two papers which were published in 2002 and 2004 received 210 and 152 citation respectively and has been listed under highly cited papers at serial numbers 3 and 7. Rest 14 paper were received 138 citation. Of these 14 paper, three did not get any citation. Two of these were published in 2014 and one in 2016.

**Table 3. Distribution of papers by impact factor**

Range of IF	No of Papers	Percent
Impact factor NA	102	37.9
$\leq 1$ (Low)	31	11.5
$> 1 \leq 2$ (Medium)	120	44.6
$\geq 3 \leq 5$ (High)	13	4.9
$> 5$ (Very high)	3	1.1
Total	269	100

## 10.2 Domestic vs International Journals

Analysis of data on papers published by Dr Sharma

indicates that these papers were scattered in 110 journal titles published from India and abroad. Analysis of data for the distribution of output in domestic and international journals is presented in Table 4. It indicates that one-fifth (20.8 %) of the papers were published in domestic journals and the remaining 79.2 per cent papers in journals published from abroad, which included both developed as well developing countries. Among the journals published abroad, highest (28 %) papers appeared in journals originating from the UK, followed by those appeared from the USA (24.2 %), and The Netherlands (15.4 %). This indicates that more than two-third (67.6 %) of the papers published by Dr Sharma appeared in journals published from these three scientifically advanced countries of the West. The preference for publishing papers by H C Sharma is similar to the publishing trend for entire Indian scientific output. However, the preferred country of choice here is UK and not the USA, a practice usually followed by Indian authors in scientific research<sup>21</sup>. Remaining papers appeared in journals those originated from other developed and developing countries.

**Table 4. Distribution of output by publishing country of journals**

Name of the Country	No of Papers	Percent
UK	77	28.6
USA	65	24.2
India	56	20.8
The Netherlands	44	16.4
Germany	10	3.7
Japan	5	1.9
Other countries*	12	4.4
Total	269	100

\*Other countries: Switzerland, Slovakia, Canada and Serbia each 2, France, Bulgaria, Spain and United Arab Emirates 1 each.

**Table 5. Most common journals used for communicating research results**

Title of the journal	No. of papers	Publishing Country	Impact Factor
Euphytica	18	The Netherlands	1.7
Crop Protection	16	UK	1.5
Insect Science and its Application	13	USA	-
Indian Journal of Plant Protection	12	India	-
Journal of Economic Entomology	11	USA	1.6
Journal of Applied Entomology	9	UK	1.7
e-Journal of SAT Agriculture Research	8	India	-
International Journal of Tropical Insect Sc.	9	UK	0.4
Entomologia Experimentalis et Applicata	7	UK	1.7
Crop Science	6	USA	1.5
Indian Journal of Entomology	6	India	-
Plant Breeding	6	UK	1.4
Annals of Applied Biology	5	UK	2.0
Biocontrol Science and Technology	5	UK	1.0
Arthropod-Plant Interactions	4	UK	1.2
Sub-total	135		
Other 95 journals publishing less than 4 articles	134		
Grand total	269		

**Table 6. Pattern of citations**

Number of times cited	Number of papers (per cent)	Total citations
0	44 (16.4)	0
1-5	50 (18.6)	146
6-10	41 (15.2)	318
11 to 15	32 (11.9)	400
16 - 20	29 (10.8)	525
21 - 25	11 (4.1)	255
26 - 35	16 (5.9)	484
36 - 50	17 (6.3)	699
51 - 100	14 (5.2)	962
101 - 500	10 (3.7)	1949
Total		5884
Citation per paper		21.9 ~ 22

## 11. MOST COMMON JOURNALS USED FOR PUBLISHING RESEARCH RESULTS

Dr Sharma published 269 research articles in 110 journal.

These journals were published from India and abroad. Table 5 lists 15 journal titles where the author published four or more papers. Of the 15 title listed in Table 5, eight were published from the UK, three each from USA and India, respectively, and one from The Netherlands. As listed in Table 4, the author preferred to publish most of his research articles in journals published from the UK and USA. Further analysis of data based on the impact factor of the journals, it is observed that the most common journals used for publishing research results were medium impact factor journals.

## 12. PATTERN OF CITATIONS AND HIGHLY CITED PAPERS

Citation rates reflect the impact of published work on international scientific community. Total 269 papers published by Dr Sharma received 5,884 citations (Table 6). Thus, the citation rate of the papers published by him is 21.9 (~ 22) per paper. Analysis of data indicates that about 17 per cent of the papers did not get any citation, and the rest were cited one or more times. Of the total cited papers, 50 (18.6 %) papers were cited between 1-5 time, and the rest cited more than five times. The proportion of papers cited 6-10 time was 15.2 per cent. Thus, about one-third (33.8 %) of the papers were cited between 1-10 time. Remaining half were cited more than 10 times, of which 117 were cited more than the average. Further analysis of data indicates that

the uncited papers were published in journals with low impact factor (0.701), of which 15.5 per cent were published during 2010-2016. Of these, 10 per cent were published during 2015-2016, thus, having a small citation window, and may be cited in future, which will further add to the total citations. Based on the pattern of publication by impact factor, publishing country of journals and the pattern of citations of the research output, one can infer that the research carried out by Dr Sharma forms a part and parcel of the mainstream agricultural sciences.

## 13. HIGHLY CITED PAPERS

Table 7 lists 10 papers, which were cited 100 or more times since their publication. All the highly cited papers were published from advanced countries of the West, except one, which was published from India. Most of these papers were published in journals having an impact factor of less than two. However, two paper were published in journals with impact factor more than two. Of these, two were published in journals with impact more than 3.

## 14. SUB-DISCIPLINES OF RESEARCH

Dr Sharma published his 269 research papers in nine different sub-disciplines of agricultural sciences. Highest number 69 papers were published in the sub-discipline of "identification and utilisation of resistance to insects" followed by "bio-safety of genetically modified plants" with

Table 7. Highly cited journal papers

Authors with bibliographic details of paper	Country	IF	TNC
War, A.R., Paulraj, M.G., Ahmad, T., Buhroo, A. A., Hussain, B., Ignacimuthu, S., Sharma, H.C. Plant Signaling and Behavior, 7 (10) 2012, 1306-1320	USA	NA	502
Dhillon, M.K., Singh, R., Naresh, J.S., and Sharma, H.C. Journal of Insect Science, 5 (1) 2005, 1-16	USA	1.3	298
Sharma, H.C., Crouch, J.H., Sharma, K.K., Seetharama, N., Hash, C.T. Plant Science, 163 (3) 2002, 381-395	USA	3.7	210
Sharma, H.C. Crop Protection, 12 (1) 1993, 11-34	UK	1.9	161
Sharma, H.C., Agrawal, B.L., Abraham, C.V., Vidyasagar, P., and Nwanze, K.F. Crop Protection, 12 (5) 1993, 343-350	UK	1.9	161
Sharma, H.C., Sharma, K.K., Seetharama, N., Ortiz, R. Electronic Journal of Biotechnology, 3 (2) 2000, 1-20	NLD	1.9	153
Sharma, H.C., Sharma, K.K., Seetharama, N., and Crouch, J.H. Critical Reviews in Plant Sciences, 23 (1) 2004, 47-72	UK	6.2	152
Sharma, H.C. Crop Protection, 17 (5) 1998, 373-386	UK	1.9	148
Sharma, H.C., and Ortiz, R. Current Science, 79 (4) 2000, 421-437	India	0.9	123
H. C. Sharma, Sujana, G., and Manohar Rao, D. Arthropod Plant Interactions, 3 (3) 2009, 151-161	NLD	1.6	105

56 papers, “breeding for resistance to insect pests” with 43 papers, “integrated pest management” with 24 and “genetically engineered plants” with 23 papers. The total number of papers published in these five sub-disciplines was 215 constituting 79.9 per cent of papers. Remaining 54 (20.1 %) papers were scattered in remaining four sub-disciplines namely “biochemical and molecular basis of insect resistance”, “phenotyping for insect resistance”, “induced resistance to insects” and “inheritance of resistance to insect pests”. Most of the papers published in these sub-disciplines appeared in top 12 journal as listed in Table 6.

## 15. CONCLUSIONS

Based on the analysis of 269 papers published by Dr H. C. Sharma between 1976-2016 indicates that he authored almost all papers in collaboration, except 11 paper as a single author. This is also indicated by high value of collaboration coefficient, which is 0.66 as well as the collaboration rate. He was most productive in the last two Quinquenniums. His productivity reached at the peak at 58 year unlike Nobel laureate Pierre-Gilles de Gennes, a French physicist, who was most productive at the age of 40 year. He has published most of his papers in medium impact factor journals published from the advanced countries of the West like the USA and the UK. The study found a strong correlation between quantity, quality and the awards and honors won by Dr Sharma. The high value of citations per paper (21.9) indicates that the research output is well connected to the main stream science.

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Dr Garg examined the collected data and wrote the final paper for submission.

**Mr Niraj Kumar** is currently working at ARSD College, University of Delhi, Delhi. He obtained his PGDCA from RCC Bihar and Jetking Certify Hardware and Networking Professional course from Jetking New Delhi. Later he completed his BLIS and MLIS from Indira Gandhi National Open University New Delhi. His area of interest is Networking, library automation, and library management software.

In the present study, he entered the data in MS Excel and analysed the data as guided by first author from time to time.