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SCIENTOMETRIC PORTRAIT OF M.S. SWAMINATHAN

V.L. KALYANE, *Scientific Officer SD, (Publication Officer), Library & Information Services Division, Bhabha Atomic Research Centre, Trombay, Bombay 400 085, INDIA*
and S.V. KALYANE, *Turning Point Centre, Nilgiri 28, Sector 5, C5, 1:3, C.B.D., Belapur, New Bombay 400 614, INDIA.*

M.S. Swaminathan was considered as a successful *role model* scientist. His 254 research publications were analysed by year, domain, journal title, and the collaboration pattern, highlighting his research style.

KEYWORDS/DESCRIPTORS: Bibliometrics; Scientometrics; Collaboration; Publication density; Publication concentration; Research group interaction; History of science; Sociology of science

1 INTRODUCTION

A school of scientific excellence is a structural unit of science formed around a creative scientist. With the evolution of such a scientific school, the initial system-forming information links of the *teacher student* type grow into better development and more profound *Originator-Follower* links manifesting themselves in direct informal links, coauthorship, fellowship and reference links. The totality of these indicators represents the specific nature and features of the scientific schools[1] and may serve as criteria for their identification. Dr. M.S. Swaminathan's pivotal role in developing the School of Agricultural Science as centre of excellence nurturing scientific culture and/or providing intellectual leadership in research was recognised by leading scientific societies of India which published a commemoration volume [2] in 1980.

The present study considers the broad spectrum of expertise of Dr. M.S. Swaminathan a worthy subject for in-depth micro analysis of his publications' productivity [3] because an important end result of scientific research is the publication of paper. It may work as standard model. Knowledge is valuable for its own sake and research has cultural value. Desire of being creative is built in our genes. Who knows this effort may switch on genes for creativity in some of those who happen to read this article. Narrating success stories always has an encouraging effect. A contest for world leadership in science and technology exists. New ways to motivate scientists seem as important to contest outcome as new sources of funds [4]. Science policy makers are also interested to know about functioning of active research teams & factors responsible for optimizing, maximising & enhancing outputs. Policy makers can react by creating better facilities for the younger generation to tap their creative potentials in time.

The number of publications serves as the scientometric indicator of the latent *Scientific productivity* [5]. Scientometrics is a subfield which applies quantitative methods to the study of science as an information process in the historical perspective of sociology of knowledge. In this information model, publications are the carriers of information, journals are the communication channels, and bibliographical references represent a special language of scientific information which shows the impact of previous research on the development of information flows. Scientific indicators may deal with individual scientist to a major science field as a whole [6].

There are three regions in the scientific research effort [7]:

1. that in which new empirical laws are discovered; then
2. the sudden issue of a qualitative transformation, following a quantitative accumulation, being characterised by a new theory; and finally,
3. the use of the theory to produce new elementary law.

2 METHODOLOGY

The informing activities of a core research group can be evaluated both quantitatively (how many publications) and qualitatively (where they are published). The informing activities of a research group were the principal focus of the present work. All papers of M.S. Swaminathan published during 1950-1980 were considered and *Normal count* procedure [8] was followed. Full credit was given to each author regardless of who happens to be the first or the last author. From the personal point of view, there is no doubt that scientists all over the world, look at their own papers exclusively in such a way. Similarly, titles of the articles were analysed and one score was allotted.

The degree of collaboration [9] in a discipline was defined as the ratio of the number of collaborative research papers to the total number of research papers published in the discipline during a certain period of time.

Vinkler [10] defined publication density as number of papers published per number of journals used; and publication concentration as number of journals containing half of the papers published times 100 per total number of journals used; during the period under study.

3 RESULTS AND DISCUSSION

Dr. M.S. Swaminathan has published 46 single author papers during 1950 to 1980. Teacher-pupil collaboration is a very common mode in an academic setting. The researcher in an institute provides the idea and guidance, teaches methodology of work, arranges for facilities, research grants, overcomes the operational difficulties, clarifies doubts of students, conducts himself in an exemplary reseacher style, sets high standards to be achieved, whereas student does most of the bench work under his supervision. Simultaneously he guides several students in different research projects. Those creative and enthusiastic team of young student researchers start functioning under the congenial research environment created by their mentor. Factors affecting quality of the research process are optimum size, age composition of the group, leadership provided, institutional *Scientific temper* nurturing climate, collaborative cooperation, team spirit, compatibility of team members, behavioural characteristics of interpersonal interaction among the researchers and ability to coordinate the dynamic group activities with feeling for sceintific accountability to achieve the desired goals...*etc.* Efficiency of the research process can be judged by completion of the project in time and essentially within budget. University department is essentially entrusted with the goal of knowledge generation and dissemination. In an information society, information generated should ideally be utilized efficiently. However, in most cases, the rate of information utilization has not increased comparably with the rate of information generation. Even though voluminous research data are being processed at extravagant costs only to be used for no practical purpose other than the write-up of reports that are seldom read by policy makers. Indeed, researchers and research managers, especially those from the academic institutions, frequently complain that policy makers and planners do not consider research findings and recommendations in their decision making [11]. Measures of the creativity of researchers include the number of research proposals generated and the number of these that receive internal or external funding. The major research output is some product, technique, better understanding of the phenomena and advancement of knowledge. While the ultimate desired outcome of research should be *benefit to human kind*, but the extent to which this is achieved is difficult to assess. Hence, we measure what is measurable rather than what is valid. It is difficult to measure the contribution of a particular project or research group to long-term nebulous objectives. A good predictor of benefit is the extent to which a particular product or technique is adopted. The extent and rate of adoption of an innovation will be determined

primarily by its appropriateness to a particular community, its viability and its cost. But rate of adoption is also difficult to measure. At least, it may take a very long time and controlled study. So, rate of adoption is not an immediate measure of the productivity or impact of research. Good predictors of rates of adoption will be extent and quality of the demonstration and informing activities of a research group. That is, the better the group demonstrates and informs its achievments, the greater its impact is likely to be. Demonstration activities include the development of prototypes or experimental materials, and the use of exhibits and training programmes of various kinds. The informing activities relate to the publications of the group, its consulting or advising activities, and its role in conference participation and organization.

Out of 118 two authorship papers, Dr. Swaminathan was the first author in 80 papers. He has contributed to 63 three authorship papers, out of which he was the first author in 15 papers, second author in 12 papers and third author in 36 papers. Four authorship papers to his credit were 21 where he was first author in 9 papers, second author in one paper and the third author in two papers and fourth author in 9 papers. In total, he had 254 papers to his credit. He was first author in 109 papers. He had collaboratorship in 208 papers (*Table 1*). Peak output year was 1963 during which 21 papers were published and the year 1961 during which 20 papers were published . These coincide with 38th year and 36th year of his age respectively.

Figure 1 depicts authorship pattern of M.S. Swaminathan, as single author, main author, and as co-author in cumulative authorships. Fluctuating trend in collaboration coefficients was prominent during second half of professional life. High level of collaboration and stability was observed during 1957-1963 which coincides with his age 32-28.

When age factor was taken into consideration he had produced three authorship papers from 29th year of age. He had four authorship papers after 31 years and five authorship papers after 45 years and six authorship papers after 44th year. This indicated a clear cut healthy trend in the span of collaboration activity. This agrees with various scholars who have noted a growing trend toward multiple authorship of scientific papers. Papers published in journals such as the *Lancet, New England Journal of Medicine, Annals of International Medicine,* and *Surgery, Gyneocology, and Obstetrics* have all experienced a rise in mean authorship in the last decade [12, 13]. Similar trend was found when collaboration trend was studied for Sugarcane Breeding Institute, Coimbatore [14]. The relationship between collaboration coefficient and average authorship per paper was in positive direction of collaboration for all disciplines though varied considerably in magnitudes. However, one should be careful while comparing group collaboration coefficient values between domains or disciplines because group collaboration coefficient values alone will not be sufficient to characterise and explain the reality [15]. Although group collaboration coefficients were higher in tissue culture, mutation and agricultural chemistry, the weighted communication values were very low since only two authorship papers were predominant in these domains.

The general finding [16, 17, 18, 19] was that scientists publish most frequently in their fourth decade of life and thereafter publication rate drops.

Zuckerman [20] compared the age distribution of american nobel laureates in science with the age distribution of american scientists in general. The majority of the nobel laureates were relatively young when they had made their prize winning discovery, but majority of the american scientists were also relatively young. Since, the age distribution for laureates matched that for scientists in general, he concluded that when allowance is made for the number of scientists at different ages, younger scientists are not more likely to be creative. However, due to their greater numerical representation, younger scientists are resposible for substantially more important contributions than older scientists.

Lehman [21] found that the majority of discoveries in science have come from individuals under the age of 40. The peak age for achievement differed between disciplines, ranging from 26-30 for Chemistry to 36-40 for Genetics, Geology, Physiology, and Psychology. Scientists remain productive, in the sense of publishing frequently, beyond 40, but what they then generate was less likely to have impact. His

Year	Single author	Two Authors			Three Authors				Four Authors					Five Authors						Six authors							Total	Collaboration co-efficient	Total publications		Age of MS Swaminathan
		I	II	T	I	II	III	T	I	II	III	IV	T	I	II	III	IV	V	T	I	II	III	IV	V	VI	T			Main author	Co-author	
1950	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.00	1	-	25
1951	1	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	0.50	1	1	26
1952	-	-	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1.00	-	2	27
1953	1	1	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	0.67	2	1	28
1954	2	1	-	1	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	0.50	4	-	29
1955	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.00	1	-	30
1956	2	5	1	6	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	9	0.78	7	2	31
1957	1	5	2	7	-	1	3	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12	0.92	6	6	32
1958	2	4	4	8	-	3	1	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14	0.86	6	8	33
1959	-	9	6	15	1	-	3	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	19	1.00	10	9	34
1960	-	2	10	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12	1.00	2	10	35
1961	1	5	5	10	1	1	5	7	-	-	-	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	20	0.95	7	13	36
1962	-	-	3	3	3	-	1	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7	1.00	3	4	37
1963	3	-	11	11	1	1	2	4	1	-	2	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	21	0.86	5	16	38
1964	2	3	-	3	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	0.67	5	1	39
1965	3	-	4	4	-	-	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	0.70	3	7	40
1966	3	-	5	5	2	-	1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11	0.73	5	6	41
1967	3	-	9	9	-	-	4	4	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	17	0.82	3	14	42
1968	-	1	7	8	2	2	1	5	5	-	-	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	18	1.00	8	10	43
1969	5	-	4	4	-	-	2	2	2	-	-	-	2	-	-	-	-	-	-	-	-	-	-	1	-	1	14	0.64	7	7	44
1970	-	-	1	1	-	2	2	4	1	-	-	4	5	-	-	-	-	3	3	-	-	-	-	-	-	-	13	1.00	1	12	45
1971	2	-	2	2	3	-	-	3	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	8	0.75	6	2	46
1972	1	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	0.50	1	1	47
1973	-	-	1	1	-	-	2	2	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	4	1.00	-	4	48
1975	2	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	0.33	3	-	50
1977	3	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	0.25	3	1	52
1978	4	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	5	0.20	4	1	53
1979	1	1	1	2	1	-	4	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	9	0.89	3	6	54
1980	2	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	0.33	2	1	55
Total	46	38	80	118	15	12	36	63	9	1	2	9	21	-	-	-	-	3	3	1	-	-	-	1	1	3	254	0.82	109	145	
Peccentage	18.11			46.46				24.80					8.27						1.18					1.18							
Cumulative per-centage	18.11			64.57				89.37					97.64						98.82					100							

I : *First Author*, II : *Second Author*, III : Third Author, IV : *Fourth Author*, V - *Fifth Author*, VI : *Sixth Author*, T : - *Total*

TABLE 1

Authorship pattern in publications of M.S. Swaminathan with collaboration coefficents and age

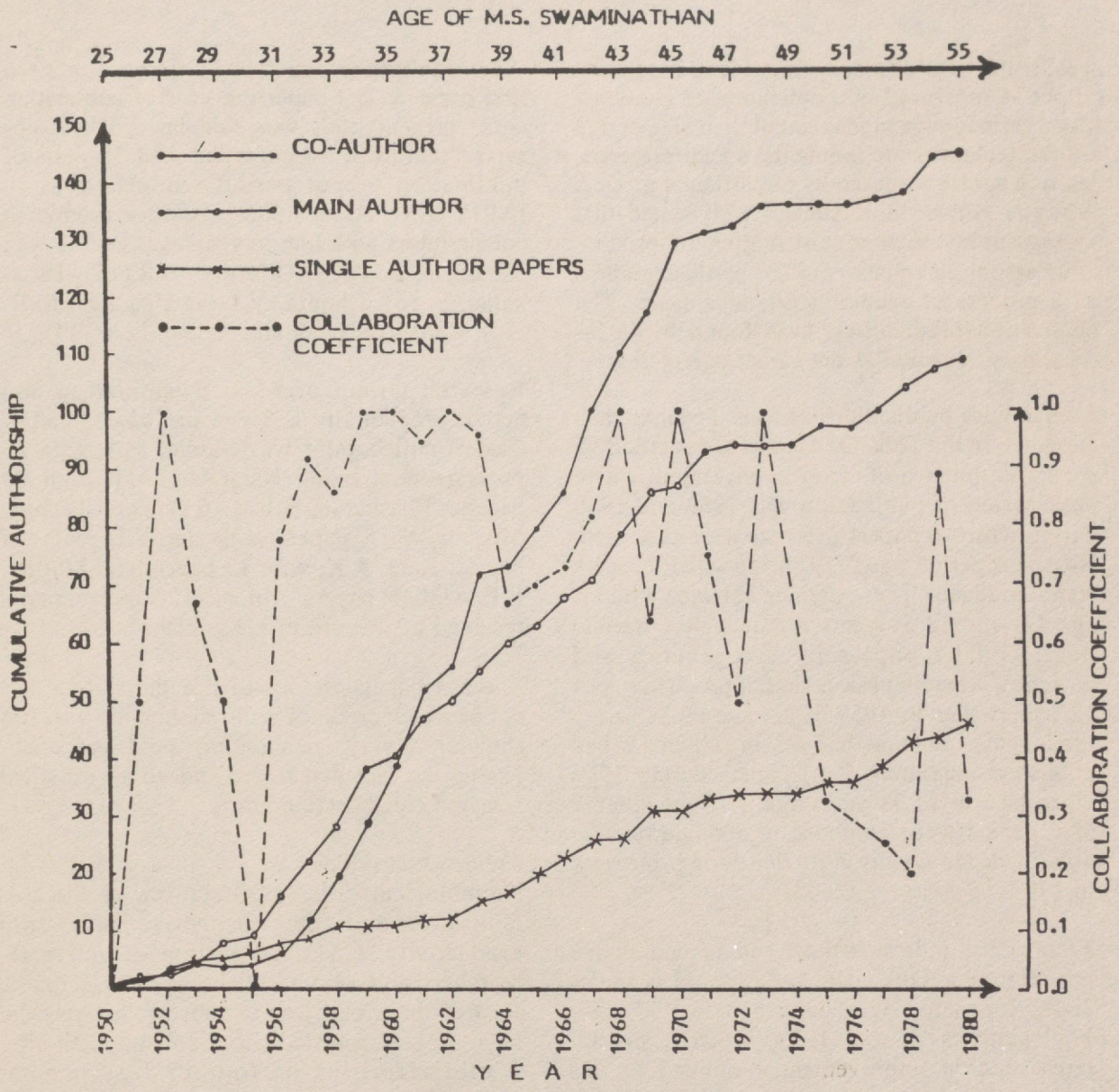

FIGURE 1
Authorship Pattern

general conclusion was that ...*genius does not function equally well throughout the years of adulthood. Superior creativity rises rapidly to a maximum which occurs usually in the thirties and then falls of slowly.*

Einstein is reported [22] to have said of scientists that *a person who has not made his great contribution to science by the age of thirty will never do so.*

The *success breeds success* phenomenon has its limits [23]. A saturation takes place and instead of accelerating their production rate, prolific authors are satisfied with their position and produce less than what could be expected from the Lotka's law.

However, Cohen [24] concluded that at the present level of ignorance management based on simple notions about a hypothetical optimal size or optimal age of research groups is likely to do more harm than good. The limited data presently available provide no grounds for encouraging or discouraging scientific or technical research groups of small or large size, or young or old

ages, if the goal of management is to maximize output as measured by publication or citations. More germane for management than size or age are the technical requirements, social preferences, and acutal productivity of particular groups. Whereas Allison and Stewart [25] stated that among highly skewed distribution of productivity among scientists could be partly explained by a process of accumulative advantage. The publication producitivity was found to be increasingly unequal as the career age increased.

Domainwise publications of M.S. Swaminathan are given in the *Table 2*. He has to his credit 95 papers in the area of crop improvement where peak period of publication was 1969 and 1970 during which 8 papers per year were produced. Next peak period was 1979 during which 9 papers were produced. These periods coincide with his age 44, 45 and 54 years respectively. He had published 87 papers in Cytogenetics and Genetics, wherein peak period of productivity of 12 papers was in 1959 at his age of 34 years. Phylogenics domain had 72 in which he had published maximum (ten) papers during 1963 when he was of 38 years age. Highest number of 6 papers were produced in a single domain *Studies in the Genus Triticum* during one year in 1963.

Figure 2 indicates the trend in cumulative papers productivity. His last paper in Genetics and Cytogenetics was published in 1971, for Phylogenetics it was 1973, whereas his interest in crop improvement continued till his voluntary retirement from the Indian Council of Agricultural Research in 1980, when he was named to the Planning Commission.

Professional life of a researcher begins with publication of his/her first paper. Papers published during the first half of professional career were 133. Papers published during the second half of professional life were 121. First 50 percent of articles were published during a period of 14 years of professional career. Second 50 percent of articles were published during 17 years of professional career although he had no publications during 1974 and 1976, when he was the Director General of the Indian Council of Agricultural Research. This has indicated continuous and uniform productivity during full span of professional life which is very rare.

When publication period *i.e.*, difference between first paper & last paper the year of publication under present study was calculated, it was observed that M.S. Swaminathan had 31 years of publication output period while he was in IARI/ICAR. Association period for prominent collaborators with him in years was as follows : Natarajan, A.T.(13); Murthy, B.R.(15); Bhaskaran, S. (6); Chopra, V.L.(9) Upadhya, M.D. (10); Kaul, A.K.(10); and Siddiq, E.A. (14).

Research Group of M.S. Swaminathan and author productivity is given in *Table 3* and *4*. Closest collaborator was Siddiq, E.A. with 26 papers; next being Natarajan, A.T. with 24 papers. Bhaskaran, S. had 16 papers, Upadhya, M.D. with 15 papers, Chopra, V.L. with 14 papers, Kaul, A.K. with 13 papers and Murthy, B.R. with 8 papers. In all 100 collaborators received the benefit of his guidance.

The 254 papers yielded total authorship of 588 out of which credit of multi-authorship was 208 showing a very encouraging trend and establishing the fact that it was indeed an excellent research collaboration group.

Figure 3 provides researchers association' in chronological order of occurance of the collaborators and their respective authorship productivity. Clear delineation of active researchers and active collaborators was found. Rest of the group was of those followers who have got dissociated from collaboration after a productivities of four or less papers. Swaminathan was a common mentor and collaborator.

Figure 4 sketches the author productivity as function of number of researchers versus number of authorships. It gives an incite that Swaminathan being engine of the research productivity and carrying compartments of collaborators following him. Indeed he was an infectious agent of enthusiasm, new ideas and a capable conductor of the research symphony orchestra.

Requisite of successful research system [26] is the development of pattern of interdisciplinary coordination within the scientific team so that it performs like a symphony orchestra. You may have a large number of research workers, each

YEAR	CYTOGENETICS AND GENETICS													PHYLOGENETICS				CROP IMPROVEMENT											TOTAL	PER-CENT-AGE	CUMLA-TIVE PER-CENT AGE
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	ZA	ZB			
1950	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.39	0.39
1951	1	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	0.79	1.18
1952	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	0.79	1.97
1953	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	1.18	3.15
1954	1	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	1.58	4.73
1955	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.30	5.12
1956	-	-	-	-	1	-	1	-	-	-	1	1	-	2	-	-	1	-	-	-	-	-	-	-	-	2	-	-	9	3.54	8.66
1957	1	-	-	-	-	-	3	-	-	-	2	-	-	-	-	-	4	-	-	-	-	-	-	-	-	1	1	-	12	4.72	13.38
1958	1	3	1	2	-	-	-	1	-	-	-	-	-	1	-	-	4	-	-	-	-	-	-	-	-	1	-	-	14	5.51	18.89
1959	-	2	-	3	-	1	-	-	1	1	1	3	-	-	-	-	3	-	-	-	1	-	-	-	-	2	1	-	19	7.48	26.37
1960	-	-	1	-	-	1	2	-	-	-	-	1	-	-	1	-	3	-	-	-	-	1	-	-	2	-	-	-	12	4.72	31.09
1961	-	-	-	-	-	2	2	-	-	1	1	-	-	1	3	-	4	1	-	-	-	1	-	-	1	-	3	-	20	7.87	38.96
1962	-	-	-	-	-	-	1	1	1	-	-	-	-	-	-	-	2	-	-	-	-	-	-	1	-	1	-	-	7	2.76	41.72
1963	-	-	-	-	-	-	1	4	1	2	-	-	-	-	6	-	4	-	-	-	-	1	-	-	-	1	-	1	21	8.27	49.99
1964	-	-	-	-	1	1	1	-	1	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1	-	6	2.36	52.35
1965	-	1	-	-	1	-	-	-	1	1	-	-	-	-	1	-	1	1	-	-	-	-	-	1	-	2	-	-	10	3.94	56.29
1966	-	-	-	-	-	-	-	1	1	-	-	-	-	-	1	-	3	2	-	2	-	-	-	-	-	-	-	1	11	4.33	60.62
1967	-	-	-	-	1	1	2	1	-	-	-	-	1	-	1	-	3	3	-	-	1	-	-	2	-	-	1	-	17	6.69	67.31
1968	-	1	1	-	1	-	1	-	3	1	-	1	-	-	-	2	1	3	-	2	-	-	1	-	-	-	-	-	18	7.09	74.40
1969	-	-	-	-	-	-	-	1	-	-	-	1	-	-	1	-	3	3	2	-	-	-	-	-	-	-	-	3	14	5.51	79.91
1970	-	-	-	-	-	-	-	1	1	2	-	1	-	-	-	-	-	1	2	2	-	-	-	-	-	1	-	2	13	5.12	85.03
1971	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1	2	1	-	1	-	-	-	-	-	2	8	3.15	88.18
1972	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1	2	0.79	88.97
1973	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1	-	-	-	1	-	-	-	-	-	-	-	-	4	1.58	90.55
1975	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	3	1.18	91.73
1977	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1	-	-	-	-	-	-	-	-	1	4	1.58	93.31
1978	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	1	-	-	-	-	-	-	-	-	1	5	1.97	95.28
1979	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	4	-	-	-	-	-	-	-	-	-	9	3.54	98.72
1980	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	1	3	1.18	100.00
Total	4	7	3	5	5	6	14	11	10	8	5	8	1	15	16	3	38	26	13	8	2	4	1	4	3	11	7	16	254		
Percent-age	1.6	2.8	1.2	1.9	1.9	2.4	5.5	4.3	3.9	3.1	1.9	3.1	0.4	5.9	6.3	1.2	15.0	10.2	5.1	3.1	0.8	1.6	0.4	1.6	1.1	4.3	2.8	6.3			
Cumu-lative percent-age	1.6	4.4	5.6	7.5	9.4	11.8	17.3	21.6	25.5	28.6	30.5	33.6	34.0	39.9	46.2	47.4	62.4	72.6	77.7	80.8	81.6	83.2	83.6	85.2	86.4	90.7	93.5	99.8			

A = Cytological techniques
B = Cytology of some Eukaryotic and prokaryotic systems
C = Numerical changes in chromosome complement
D = Induced Structural changes
E = Mutagenic specificity using cytological anomalies
F = Organization of chromosomes at Molecular level
G = Polyploidy and Mutagen sensitivity
H = Cytotoxic and Mutagenic effects of irradiated substrates including Food Materials
I = Enhancement of Mutation frequency and alternation of mutation spectrum
J = Cytological Investigations in the Genus Triticum
K = Tobacco
L = Gene Mapping through aneuploid analysis
M = Human Genetics
N = Tuber bearing Solanum Species.
O = Studies in Genus Triticum
P = Studies in Rice
Q = Induced Mutagenesis
R = Wheat
S = Rice
T = Induced Mutagenesis
U = Brassica
V = Cotton
W = Tomato
X = Barley
Y = Coconut
Z = Forage crops
ZA = Jute
ZB = Combating under-nutrition and malnutrition.

TABLE 2

Domainwise Publications of M.S. Swaminathan

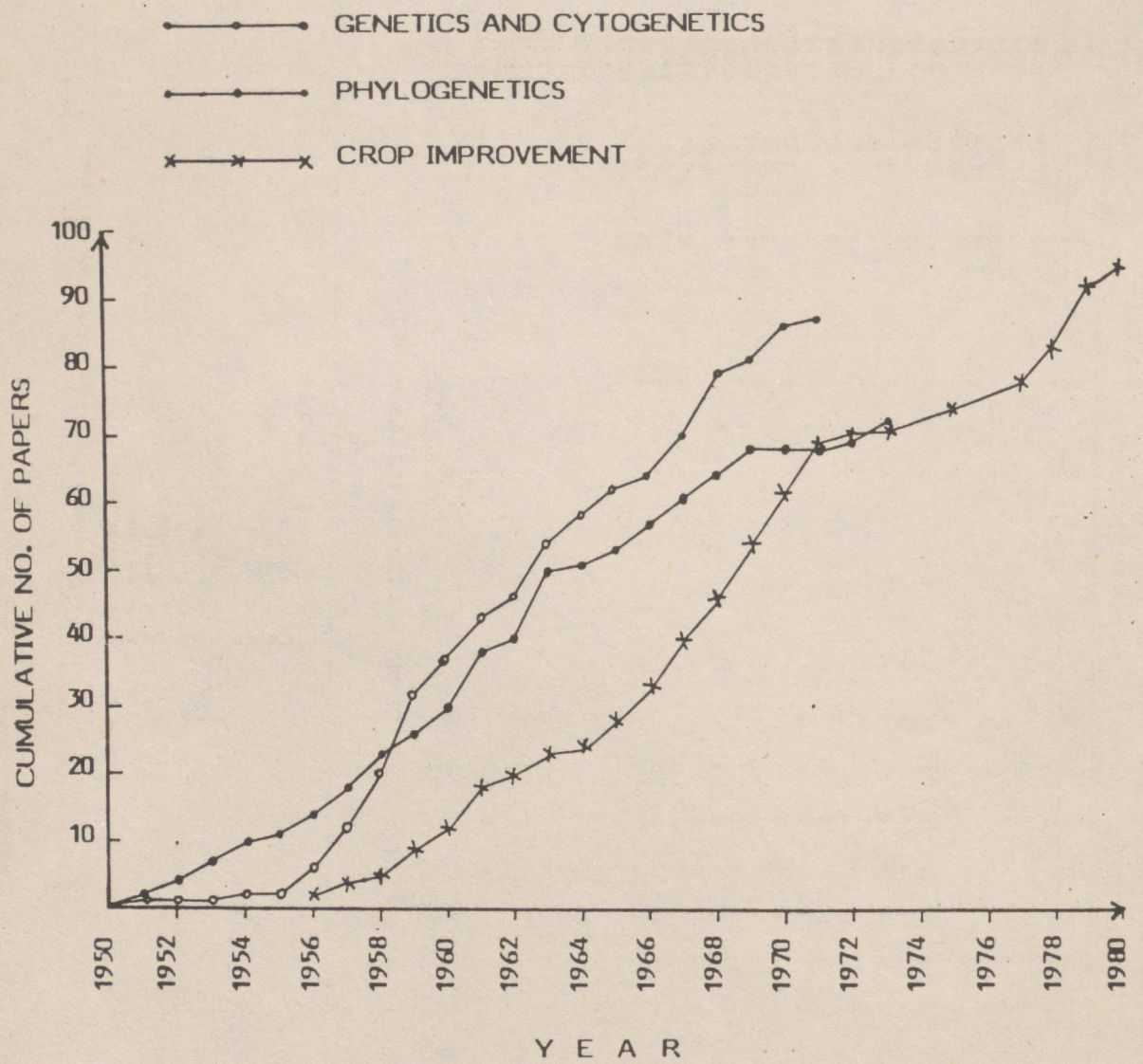

FIGURE 2
Disciplinewise Productivity of M.S. Swaminathan

with a high degree of individual competence, but what is more important is combined excellence of the whole group. As in the case of the symphony orchestra, the capability of the conductor is especially important for drawing out the best in each member of the team and for inculcating a spirit of pride in performance.

Generally, positive relationship exists between collabortion and quality [27]. Gains from collaboration may be apparent by more productive quantitative output of scientific knowledge, more efficient use of scientific technology, and more subjective positive involvement of individuals in the research output process.

One of the surprising results of Roy [28] was the very strong correlation of total citation with total number of papers published. This serves to confirm the correlation of quality with produtivity of published research. So, in order to rank-order facility research effectiveness of total citation, one could as well have rank-ordered them by total papers published.

Like many natural phenomena, the growth of scientific knowledge appears to be cluster-like. This seems to be true in a physical sense. On a spacial scale, scientific discussion mainly *Cluster* around important universities, governmental and industrial research institutions. On a temporal

Sl. No.	Name	S	A			B				C					D						E							Total	Years Paper	+
		I	I	II	T	I	II	III	T	I	II	III	IV	T	I	II	III	IV	V	T	I	II	III	IV	V	VI	T		First	Last
1.	Swaminathan,M.S.	46	38	80	118	15	12	36	63	9	1	2	9	21	-	-	-	-	3	3	1	-	-		1	1	3	254	1950	1980
2.	Prakken,R.	-	2	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1951	1952
3.	Howard,H.W.	-	2	1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	1952	1953
4.	Hougas,R.W.	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1954	1954
5.	Magoon,M.L.	-	-	1	1	-	1	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	1954	1961
6.	Mehta,K.L.	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1954	1954
7.	Nath,J.	-	1	2	3	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	1956	1970
8.	Natarajan,A.T.	-	2	12	14	3	3	2	8	-	-	1	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	24	1956	1968
9.	Murthy,B.R.	-	2	5	7	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	8	1956	1970
10.	Sikka,S.M.	-	2	1	3	-	1	-	1	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	5	1956	1960
11.	Singh,M.P.	-	2	1	3	-	1	-	1	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	5	1956	1960
12.	Pal,B.P.	-	-	-	-	2	-	-	2	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	3	1956	1958
13.	Ganesan,A.T.	-	1	2	3	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	1957	1958
14.	Shah,S.S.	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1957	1957
15.	Bhaskaran,S.	-	8	-	8	2	1	3	6	-	-	2	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	16	1957	1962
16.	Mehta,R.K.	-	2	-	2	2	1	2	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7	1958	1965
17.	Sulbha,K.	-	1	1	2	-	1	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	1959	1961
18.	Ray,M.	-	1	-	1	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1959	1961
19.	Pai,R.A.	-	3	-	3	-	1	-	1	2	-	1	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	7	1959	1970
20.	Jha,K.K.	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1959	1959
21.	Ninan,T.	-	-	-	-	1	1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1959	1959
22.	Chopra,V.L.	-	4	-	4	4	4	1	9	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	14	1960	1968
23.	Nambiar,M.C.	-	2	1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	1960	1961
24.	Sastry,G.R.K.	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1960	1960
25.	Prabhakara Rao,M.V.	-	2	2	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	1960	1963
26.	Brewbaker,J.L.	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1960	1960
27.	Rao,M.V.P.	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1960	1960
28.	Iyer,R.D.	-	-	1	1	1	1	2	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	1961	1970
29.	Jagathesan,D.	-	2	-	2	3	1	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	1961	1963
30.	Kamra,S.K.	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1961	1961
31.	Upadhya.M.D.	-	10	2	12	-	1	-	1	-	2	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	15	1961	1970
32.	Patel,K.A.	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1961	1961
33.	Bhatia,C.R.	-	3	-	3	1	2	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	1961	1963
34.	Gupta,N.	-	2	-	2	-	-	1	1	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	4	1961	1970
35.	Nirula,S.	-	-	-	-	1	-	-	1	1	1	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	3	1961	1963
36.	Mehra,K.L.	-	-	-	-	1	-	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1962	1970
37.	Subramanyam,K.N.	-	-	-	-	-	3	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	1962	1965
38.	Gopal Ayengar,A.R.	-	1	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1963	1964
39.	Puri,R.P.	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	3	-	-	3	-	-	-	-	1	-	1	5	1963	1971

TABLE 3
Collaborators of M.S. Swaminathan

C ontd...

Table 3 *(contd...)*

Sl. No.	Name	S	A			B				C					D						E							Total	Years Paper	
		I	I	II	T	I	II	III	T	I	II	III	IV	T	I	II	III	IV	V	T	I	II	III	IV	V	VI	T		First	Last
40.	Kaul,A.K.	-	-	-	-	3	-	2	5	1	2	2	-	5	-	3	-	-	-	3	-	-	-	-	-	-	-	13	1963	1972
41.	Dhar,R.D.	-	-	-	-	-	3	-	3	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	4	1963	1972
42.	Ahnstrom,Gunnar	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1963	1963
43.	Sharma,R.P.	-	-	-	-	-	-	1	1	-	1	-	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	3	1963	1970
44.	Kantha,Sachar	-	-	-	-	2	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1964	1967
45.	Kesawan,P.C.	-	5	-	5	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	1965	1971
46.	Kapoor,M.L.	-	-	-	-	-	3	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	1965	1966
47.	Banerjee,S.K.	-	3	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	1966	1966
48.	Kohli,S.P.	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1966	1966
49.	Anderson,R.G.	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1966	1966
50.	Sastry,G.R.K.	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1966	1966
51.	Gupta,A.K.	-	2	-	2	-	-	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	1967	1968
52.	Varughese,G.	-	3	-	3	-	-	-	-	-	-	-	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	6	1967	1968
53.	Rana,R.S.	-	1	-	1	-	2	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	1967	1968
54.	Siddiq,E.A.	-	5	-	5	1	8	1	10	1	5	-	-	6	3	-	-	-	-	3	-	1	-	1	-	-	2	26	1967	1980
55.	Bhatia,D.	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1967	1967
56.	Upadhya,L.P.	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1967	1967
57.	Prasad,M.V.R.	-	-	-	-	2	1	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	1967	1973
58.	Krishnaswamy,R.	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1967	1967
59.	Kumar,S.	-	-	-	-	2	-	-	2	1	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	3	1967	1967
60.	Aggarwal,U.	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1967	1967
61.	Bansal,H.C.	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1967	1967
62.	Singh,D.	-	-	-	-	-	-	-	-	-	-	1	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1967	1968
63.	Sharma,N.P.	-	-	1	1	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1968	1968
64.	Majid,Rehana	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1968	1968
65.	Savin,V.N.	-	-	-	-	1	-	-	1	-	-	3	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	4	1968	1968
66.	Sharma,B.	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1968	1968
67.	Joshi,L.M.	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1968	1963
68.	Rao,M.V.	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1968	1968
69.	Dakshinamurthi,C.	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1968	1968
70.	Joshi,B.C.	-	-	-	-	1	-	-	1	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1968	1970
71.	Jha,M.P.	-	1	-	1	-	-	-	-	2	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	3	1969	1970
72.	Austin,A.	-	-	-	-	-	-	-	-	-	1	-	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1969	1969
73.	Naik,M.S.	-	-	-	-	-	-	-	-	-	1	-	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1969	1969
74.	Bains,S.S.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	1	1969	1969
75.	De,Rajat.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1	1	1969	1969
76.	Mahapatra,I.C.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	1	1969	1969
77.	Venkataraman	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	1	1969	1969
78.	Chanchal,Sarin	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1970	1970
79.	Ismail,M.A.	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	2	1970	1971
80.	Raghaviah,P.	-	-	-	-	-	-	-	-	-	-	2	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1970	1970

Table 3 *(Contd...)*

Sl. No.	Name	S	A			B				C					D						E						Total	Year Paper	
		I	I	II	T	I	II	III	T	I	II	III	IV	T	I	II	III	IV	V	T	I	II	III	IV	V	VI	T		First	Last
81.	Singh,C.B.	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	1	-	-	1	2	1970	1971
82.	Guha,Sipra	-	-	-	-	-	-	-	-	1	1	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1970	1970
83.	Dhawan,N.L.	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1970	1970
84.	Rao,N.G.R.	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1970	1970
85.	Singh,V.P.	-	-	-	-	2	-	-	2	1	-	-	-	1	-	-	-	3	-	3	-	-	-	-	-	1	1	7	1970	1979
86.	Siddique,J.A.	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1971	1971
87.	Sharma,S.D.	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1971	1971
88.	Joshi,M.C.	-	-	-	-	1	1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1973	1973
89.	Vairavan,S.	-	-	-	-	-	-	-	-	1	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1973	1973
90.	Arunachalam,V.	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1973	1973
91.	Jain,H.K.	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1975	1975
92.	Mehra,R.B.	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1978	1978
93.	Sinha,S.K.	-	1	-	1	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1979	1979
94.	Hogen,Esch,J.A.	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	2	1979	1979
95.	Parmar,K.S.	-	-	-	-	4	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	1979	1980
96.	Sneep,J.	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1979	1979
97.	Hendriksen,A.J.T.	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1979	1979
98.	Zwartz,J.A.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	1	1979	1979
99.	Hautvast,J.G.A.J.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1	1	1979	1979
100.	Hendrickx,H.K.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	1	1979	1979
101.	Lunven,P.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	1	1979	1979
	Total	**46**	**118**	**118**	**236**	**63**	**63**	**63**	**189**	**21**	**21**	**21**	**21**	**84**	**3**	**3**	**3**	**3**	**3**	**15**	**3**	**3**	**3**	**3**	**3**	**3**	**18**	**588**		
	Percentage	7.82			40.14				32.14					14.29						2.55							3.06			
	Cumulative Percentage	7.82			47.96				80.10					94.39						96.94							100.0			

I : *First Author*, II : *Second Author*, III - *Third Author*, IV : *Fourth Author*, V : *Fifth Author*, VI - *Sixth Author*, T : *Total*
S : *Single Author*, A : *Two Authorship papers*, B : *Three Authorship papers*, C : *Four Authorship papers*, D : *Five Authorship papers* E : *Six Authorship papers*

No. of papers	Active collaborators	Total No. of researchers	Total authorships (%)	%	Cumulative percentage
1		44	44	7.48	7.48
2		16	32	5.44	12.92
3		13	39	6.63	19.55
4		9	36	6.12	25.67
5		3	15	2.55	28.22
6		4	24	4.08	32.30
7		4	28	4.76	37.06
8	Murthy, B.R.	1	8	1.36	38.42
13	Kaul, A.K.	1	13	2.21	40.63
14	Chopra, V.L.	1	14	2.38	43.01
15	Upadhya, M.D.	1	15	2.55	45.56
16	Bhaskaran, S.	1	16	2.72	48.28
24	Natarajan, A.T.	1	24	4.08	52.36
26	Siddiq, E.A.	1	26	4.42	56.78
254	Swaminathan, M.S.	1	254	43.20	99.98

TABLE 4
Author Productivity

scale, scientific discoveries often occur in a relatively short period of time, since an important breakthrough makes new advancements possible.

The journals *(Table 5)* where Swaminathan had published more than 10 papers were Indian J.Genet. (26); Current science (36); Nature, and Radiation Botany with twelve each; whereas Wheat Information Service had 10 papers. Publication density and publication concentration was found out to be 4.46 and 8.33 respectively.

4 CONCLUSION

This study has clearly demonstrated that list of publications of a successful scientist can be analysed scientometrically and it can throw light on history of science, scientific development, interactions in a research group, organization of a research system, sociology of knowledge and quality of scientific leadership.

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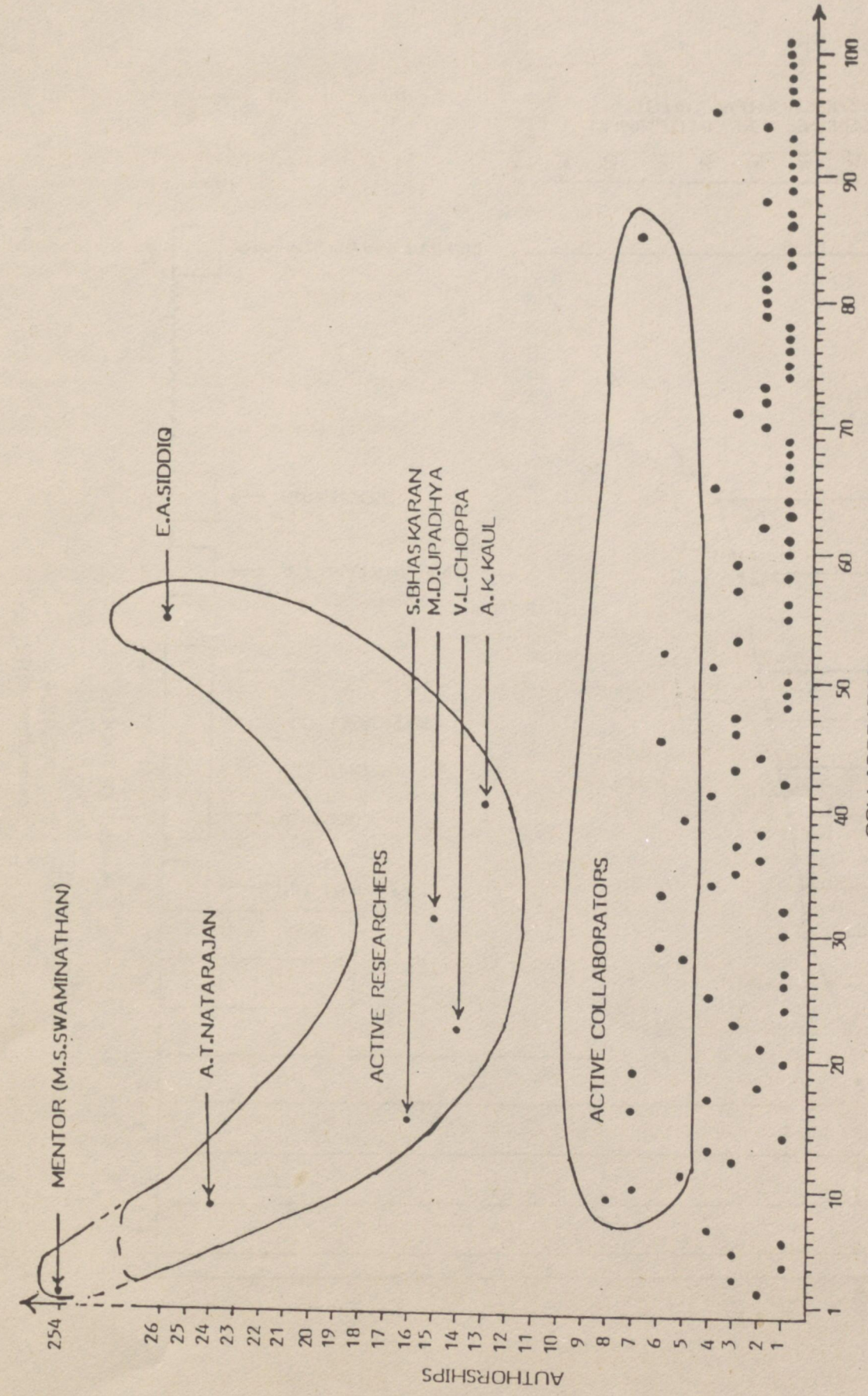

FIGURE 3
Researchers Association in Chronological Order of Occurrence

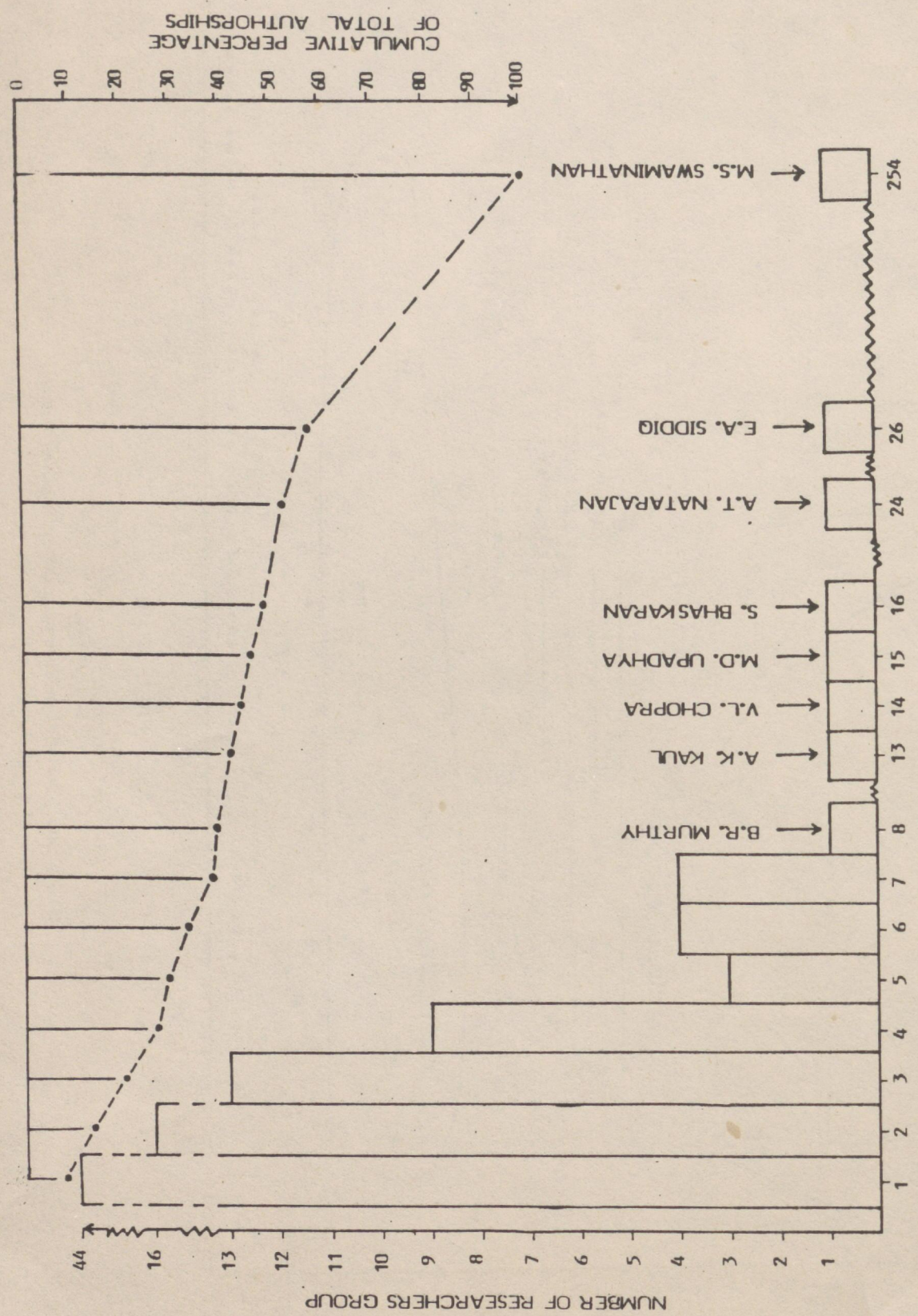

FIGURE 4
Author Productivity

Sl. No.	Journal Titles/Channels of communication	Total Papers	Percent-age	Cumulative percentage	Period of Journal usage FPY	LPY	Total
1.	Indina J. Genet.	46	18.11	18.11	1954	1980	27
2.	Curr. Sci.	36	14.17	32.28	1956	1979	24
3.	Nature	12	4.72	37.00	1955	1963	9
4.	Radiation Botany	12	4.72	41.72	1962	1971	10
5.	Wheat Information Service	10	3.9	45.66	1956	1970	15
6.	Indian Farming	8	3.15	48.81	1965	1978	14
7.	Mutation Research	6	2.36	51.17	1967	1970	4
8.	Science	5	1.97	53.14	1959	1963	5
9.	Naturwissenschaften	5	1.97	55.11	1958	1963	6
10.	Genetica	5	1.97	57.08	1952	1963	12
11.	Euphytica	5	1.97	59.05	1952	1963	12
12.	Genetics	5	1.97	61.02	1954	1969	16
13.	Experimental cell Research	4	1.57	62.59	1960	1967	8
14.	Chromosoma	4	1.57	64.16	1961	1963	3
15.	Experientia	3	1.18	65.34	1967	1958	2
16.	J.Indian bot. Soc	3	1.18	66.52	1959	1963	5
17.	J.Heredity	3	1.18	67.70	1954	1959	6
18.	Sci. and Cult.	3	1.18	68.88	1977	1978	2
19.	Z.Pflanzenzuchtg	3	1.18	70.06	1962	1967	6
20.	X.Vererbungslehre	3	1.18	71.24	1959	1959	1
21.	American Potato Journal	2	0.79	72.03	1951	1953	3
22.	IARI PG School Journal	2	0.79	72.82	1965	1967	3
23.	Nucleus	2	0.79	73.61	1958	1970	3
24.	Stain Technology	2	0.79	74.40	1957	1958	2
25.	Theor. Appl. Genet.	2	0.79	75.19	1973	1979	7
26.	Hereditas	1	0.39	75.58	1966	1966	1
27.	Amer. J. Bot.	1	0.39	75.97	1954	1954	1
28.	Ann. hum. Genet.	1	0.39	76.36	1967	1967	1
29.	Adv. Genet.	1	0.39	76.75	1961	1961	1
30.	Bot. Zenter	1	0.39	77.14	1968	1968	1
31.	Bibliographia Cenetica	1	0.39	77.53	1963	1963	1
32.	Caryclogia	1	0.39	77.92	1963	1963	1
33.	Cytologia	1	0.39	78.31	1970	1970	1
34.	Genetica Argaria	1	0.39	78.70	1950	1950	1
35.	Human Chromosome Newsletter	1	0.39	79.09	1965	1965	1
36.	D.I.S.	1	0.39	79.48	1963	1963	1
37.	Der Zuchter	1	0.39	79.87	1950	1950	1
38.	Evolution	1	0.39	80.26	1960	1960	1
39.	Indian Bot. Soc. Mem.	1	0.39	80.65	1958	1958	1
40.	Indian J.Exptl. Biol.	1	0.39	81.04	1965	1965	1
41.	Indian J.Hort.	1	0.39	81.43	1958	1958	1
42.	J.Appl. Biol.	1	0.39	81.82	1965	1965	1
43.	Indian Cotton Growing Reviews	1	0.39	82.21	1963	1963	1
44.	SABRAO Newsletter	1	0.39	82.60	1969	1969	1
45.	Meded Landouushogeschool Wageningen	1	0.39	82.99	1951	1951	1
46.	Radiation Research	1	0.39	83.38	1962	1962	1
47.	Proc. Indian Acad Sci.(B)	1	0.39	83.77	1960	1960	1
48.	Tobacco Science	1	0.39	84.16	1961	1961	1
49.	Papers presented in various meetings, conferences, Synopsia, book, bulletins:						
	Abroad	30	11.81	95.97	1959	1980	22
	India	10	3.94	99.91	1967	1978	12

FPY : *First paper published year*, LPY : *Last paper published year*

TABLE 5
Scattering of papers of M.S. Swaminathan

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