

Plant flow cytometry: a scientometric analysis of documentary arrays from Scopus and Web of Science databases

Valentina Rykova^{1*}, and Maria Voronkova²

¹State Public Scientific Technological Library of the Siberian Branch of the Russian Academy of Sciences

²Central Siberian Botanical Garden of the Siberian Branch of the Russian Academy of Sciences

Abstract. The article presents a scientometric analysis of documentary arrays selected of the world science citation databases Scopus and Web of Science on the topic "Plant flow cytometry". The analysis of documentary arrays shows their positive dynamics and especially active growth currently. It names countries and organizations actively carrying on research in the area, and leading in the publication amount; rating journals with high publication activity, authors who work productively on the topic. The paper reveals thematic structure of the studied corpus of documents and highly cited publications.

1 Introduction

The effective method to estimate the genome size is a flow cytometry technique, which has been successfully used recently to assess the genetic diversity of the whole number of plant organisms; solve taxonomic issues, species evolution and dynamics, problems of natural hybridization and polyploidy [1]. Flow cytometry becomes an important part of complex botanical research and is applied in phylogenetic constructions in plant taxonomy, population studies, floristics, breeding and biotechnology.

The work objective is a scientometric analysis of the document corpus devoted to the plant research with flow cytometry using analytical tools of the world science citation databases (DB) Web of Science (WoS) by Thomson Reuters Co and Scopus of the Elsevier publishing corporation.

2 Materials and Methods

The authors have formulated search queries using keywords and Boolean operators for the above DBs: Scopus - TITLE-ABS-KEY (“flow cytometry” AND plant); WoS - TS=(“flow cytometry” AND plant). As this method is widely used in medicine, veterinary, agriculture, and pharmacology, it was necessary to refine the query using DB filters (branch of

*Corresponding author: bmc_87@mail.ru

knowledge, WoS categories, keywords, etc.). As a result, document arrays (DA) of relevant publications were obtained, which amount on April, 2020 in DB Scopus was 2765 documents (694 of them are Open Access), and 2762 works in DB WoS (788 – Open Access).

Using the DB analytical tools, the studied DAs were evaluated by the following parameters: temporal dynamics of publications; publication distribution by country; authors and organizations leading in the number of publications; document type structure; the most productive journals, thematic categories, frequently cited publications.

3 Results and discussion

Fig. 1 shows the four decade dynamics of the DAs selected of DBs1, where it is possible to trace development stages of the scientific direction: 1) the 1980-90s - publications on the subject were rare, mainly in the field of agriculture; 2) the 1990s-early 2000s - information volume increased (from 10 works at the end of the last century to 50 publications annually by the new millennium start); 3) the 2010s - intensive information growth was observed, the document number was above 100-150 publications a year, the maximum (187 works) was recorded in WoS in 2018. The analysis of Das' temporal evolution indicates the relative youth of this research area and the growing popularity of flow cytometry among scientists and specialists studying plants.

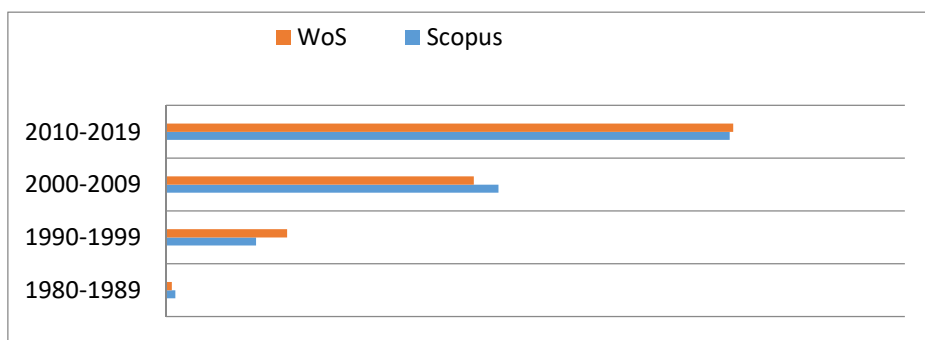


Fig. 1. Dynamics of DAs in DBs Scopus and WoS for 40 years.

This method is used in different countries, their list includes in each DB over 110 states, the paper's authors of the analyzed DAs are affiliated with them. The top 10 countries with high publication activity on the topic are presented in Table 1. By the work number, the first 3 places in both DBs are taken by the USA, China, Czech Republic. The further list of countries is the same, but with different position in DBs (France, Germany, Japan, Spain, Poland, Great Britain, Brazil). Russia is twenty-eighth in the ranking of both DBs (32 works - in Scopus and 29 - in WoS); the author's teams are represented by researchers from Moscow, St. Petersburg, Novosibirsk, Barnaul, Krasnoyarsk and Sochi. It should be noted that articles by Russian scientists in the world DB of science citation have recently been published, but their number is growing due to the active work of Russian publishers to include their journals in Scopus and WoS, as well as the papers in the international editions by domestic scholars.

The authors of publications are affiliated with lots of organizations in DBs Scopus and WoS, their leaders according the publication amount are institutions of the Czech Academy of Sciences, Charles University (Prague), the French National Center for Scientific Research, the National Research Institute for Agriculture, Food and the Environment (France) and others (Table 2). In addition to affiliation, many publications indicate

organizations sponsored research, where the National Science Foundation of China and the Czech Science Foundation take two top places in the ranking of both DBs ; the third place is taken by the US National Science Foundation (Scopus) and the Brazilian National Council for Science and Technology Development (WoS).

Table 1. Countries with high publication activity on the issue*.

	Scopus		WoS	
	Country	Document amount	Country	Document amount
1	USA	547	USA	513
2	China	307	China	284
3	Czechia	238	Czechia	271
4	France	228	Germany	219
5	Germany	205	France	205
6	Japan	200	Japan	188
7	Spain	173	Spain	157
8	United Kingdom	135	Poland	129
9	Brazil	105	Brazil	128
10	Poland	104	United Kingdom	109

*the lower ranking threshold is over 100 documents in DB.

Table 2. Top-5 organizations affiliated with paper authors in DBs.

Nº	Scopus	Document number	WoS	Document number
1	Academy of Science of Czech Republic: - Institute of Botany - Institute of Experimental Botany	102 88 81	Academy of Science of Czech Republic: - Institute of Botany - Institute of Experimental Botany	200 110 89
2	Charles University, Czechia	85	Charles University, Czechia	107
3	French National Centre for Scientific Research, France	75	French National Centre for Scientific Research, France	85
4	University of Technology and Life Science in Bydgoszcz, Poland	49	French National Research Institute for Agriculture, Food and Environment	83
5	University of Vienna	48	US Department of Agriculture	81

DAs are homogeneous in language composition, the most papers are in English (98% - Scopus, and 99% - WoS), publications in other languages are sporadic, among them are Chinese, French, Portuguese, Russian, German, Spanish, etc.

The type composition of the document corpus in DBs is similar (Table 3): over 90% of works are represented by articles in periodicals, conference proceedings make up 6% in WoS and 3% in Scopus, respectively. Other document types are few in DAs, they are presented by reviews, discussions, letters, editorial notes published in journals as well. Such a set of documents is explained by the specifics of the aforementioned DBs, which were created as science citation DBs including mainly articles in journals, and conference proceedings usually published in ongoing editions.

Table 3. The document type composition in DBs Scopus and WoS on the issue.

DB	Scopus		WoS	
	Publication number	%	Publication number	%
Articles in periodicals	2555	92.5	2510	90.8
Conference proceedings	92	3.3	190	6.7

Reviews	58	2.1	60	2.1
Book chapters	45	1.6	34	1.2
Others	13	0.5	6	0.2

It should be noted that periodicals are the most efficient source of information, reflecting the latest scientific achievements. The journal titles with the highest publication activity on the topic are shown in Table 4, which evidences the 1st-5th and 7th positions in the ranking of periodicals in DBs Scopus and WoS are the same (only, editions *Annals of Botany* and *Acta Horticulturae* vary the 2nd and 3rd places), the 6th place is distinguished by the periodical titles *Euphyta* (Scopus) and *Plant Systematics and Evolution* (WoS). All editions (except *Acta Horticulturae*) are the first quartile (Q1) journals in categories Plant Science, Agromony and Crop Science or Horticulture.

Table 4. Rating journals with high publication activity on the topic in DBs*.

	Scopus		WoS	
Rating	Edition title	Publication number	Edition title	Publication number
1	Plant Cell Tissue and Organ Culture	158	Plant Cell Tissue and Organ Culture	177
2	Annals of Botany	133	Acta Horticulturae	137
3	Acta Horticulturae	89	Annals of Botany	117
4	Plant Cell Reports	78	Plant Cell Reports	76
5	Scientia Horticulturae	68	Scientia Horticulturae	73
6	Euphyta	60	Plant Systematics and Evolution	71
7	Plant Science	58	Plant Science	58

*only editions included above 50 papers on the topic.

The list of authors with high publication activity on the topic in Scopus and WoS is almost the same, only the authors' ranking places and number of works published by them differ (Table 5). The most productive authors are Dolezel J., Head of the Laboratory of Molecular Cytogenetics and Cytometry at the Institute of Experimental Botany of the Czech Academy of Sciences; Suda J., a researcher at Charles University (Prague, Czech Republic); Sliwiska E, Head of the Laboratory of Molecular Biology and Cytometry, Univ.ersity of Technology and Agriculture (Bydgoszcz, Poland); Loureiro J., employee of the Center for Functional Ecology, University of Coimbra (Portugal).

Table 5. Authors with high publication activity on the topic in DBs*.

Rating	Author	Scopus	WoS
1	Dolezel J.	66	83
2	Suda J.	44	52
3	Sliwiska E	33	44
4	Loureiro J.	32	41
5	Santos S.	26	37
6	Travnicek P.	22	34
7	Rayburn A.L.	16	32

* the lower ranking threshold is over 30 documents at least in any DB on the topic.

Thematically the publications in DB Scopus are grouped by branch of knowledge: Agriculture and Biological Sciences (54%), Biochemistry, Genetics & Molecular Biology (37%), Environmental Sciences (6%), Chemistry (3%); in DB WoS materials are distributed by research areas: Plant Science (61%), Agriculture (26%), Biotechnology, Applied Microbiology (14%), Biochemistry, Molecular Biology (12%), Genetics, Heredity

(10%). In addition to research areas, WoS shows the paper distribution by WoS subject categories, which in the analyzed DA coincide with the research areas. DB Scopus has a “keywords” filter; in this option, the most common key words are the following: flow cytometry (2247 documents), genetics (683), polyploidy (464), metabolism (404), etc.

The “Citation Analysis” tool revealed works that are most often cited by authors of other publications. They are Dolezel, Greilhuber, Suda (2007) [2], Bennett, Leitch (1995) [3], and Dolezel, Bartos (2005) [4], each has been cited more than 500 times.

DA selected in WoS is used to visualize the research area with Cite Space software [5], which shows (Fig. 2) independent thematic clusters marked by keywords based on the document co-citing network.

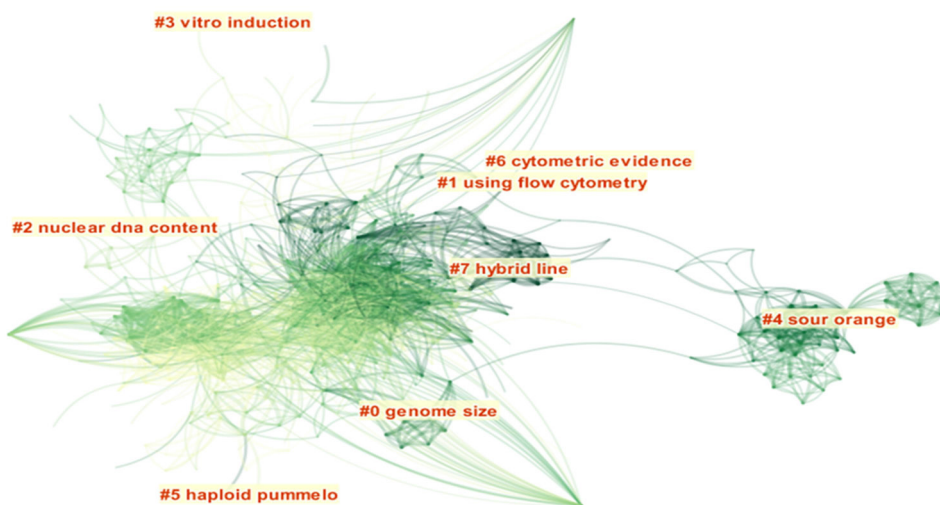


Fig. 2. Thematical clusters of the research field “Plant flow cytometry” marked by keywords

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