

Bibliometric analysis of studies on tomato production done to date

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ABSTRACT

By bibliometrically analyzing 504 papers and 138 reference materials published in the field of tomato production between 1992 and 2023, the research seeks to determine the patterns and tendencies in the subject during the previous 31 years. In this case, bibliometric information from the studies was found by doing a search for "tomato production" in the "Web of Science Core Collection" Database. According to the results of the analysis, the highest number of publications was recorded in 2022, with 80 publications. According to number of publications, Li Y (13), Chen X (11), Jones JB (10), Li J (10), Miller SA (10), Vallad GE (10) and Wang J (10) are the writers with the most on tomato production. The most frequently used keywords in the publications related to the subject were *solanumlycopersicum*, plant diseases, and animals. These words are performed 264, 141, and 82 times accordingly. The journals with the highest number of papers published include *Plant Disease* (74 articles overall), *Plants* (Basel, Switzerland), with 27 articles overall, and *Phytopathology* (24 articles). The China College of Horticulture and Landscape Architecture, Northeast Agricultural University and College of Life Sciences, Northeast Agricultural University China and Department of Horticultural Science, Gyeongnam National University of Science and Technology (Gntech), Korea has played a key role in affiliations collaborations.

Keywords: Tomato, bibliometrics, agriculture.

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I. INTRODUCTION

The tomato (*Lycopersicon esculentum*, Miller, 1768) is a member of the Solanaceae family and order of plants. It was formerly known as *Solanumlycopersicon*, Linnaeus, 1753. The family is one of the most diverse groups of flowering plants, with between 1500 and 2000 species (Sato et al., 2012; Naika et al., 2005).

The tomato (*Solanumlycopersicum L.*) is the most widely grown crop in home gardens and is consumed worldwide second only to potatoes (*Solanumtuberosum L.*). Although the species originated in Mexico, it is endemic to South America and may have spread to Peru and Ecuador (Benton, 2007).

The taste, color, flavor, and nutritional value of tomatoes have led to their widespread cultivation worldwide. It can be treated or consumed raw. Given that tomatoes are low in calories and high in vitamins A, C, and minerals, they may be a beneficial addition to a diet that is nutritious and well-balanced. It offers trace levels of the B complex vitamins, including niacin, riboflavin, and thiamin (Sainju and Dris, 2006).

For traditional genetic and genomic research, the tomato serves as a model species. Despite reports of instances of $2n=2x=26$, its chromosomal number is $2n=2x=24$. Roughly twelve wild cousins exist for the cultivated tomato. The tremendous genetic variety seen in these wild tomatoes has been essential in the development of contemporary tomato cultivars. As a result, the market now wants tomato hybrids and cultivars with varying degrees of polyploidy. As a result, a large number of types are currently extensively produced, occasionally in greenhouses in colder locations (Sato et al., 2012).

Tomatoes belong to the Solanaceae family, which also contains Irish potatoes, tobacco, eggplant, and peppers. The western coastal plain of South America, spanning from Equador to Chile, is where the tomato originated. Mexico was the first place where tomatoes were domesticated, and a range of sizes and hues were chosen. The mid-1500s saw the introduction of the fruit to Europe (Kelley et al., 2010). Because they belong to the nightshade family, tomatoes were long thought to be harmful. Yes, this family of crops has a large number of extremely dangerous alkaloids. Toxic amounts of tomatine are found in tomato leaf, but the fruit enzymatically transforms them into a non-toxic form. The crop was not used for food in England or France until the 18th century as a result of these misconceptions (Kelley et al., 2010).

Turkey's production of industrial tomatoes is regarded as a major supply of raw materials for the tomato processing sector. Many rural households make a living from tomato farming, which also provides jobs for a significant portion of the labor force (Çetin and Vardar, 2008).

Tomato is a horticulture plant and bibliometric analysis studies have been published on some garden plants (Çelik, 2024; Ikhwan et al., 2024; Yuan et al., 2021).

This study uses bibliometric analysis to assess the evolution of papers published on tomato production by year, journal, author, and subject.

II. MATERIALS AND METHOD

The data presented in this study consist of 504 studies on wrestling sports that were published between 1992 and 2023 and scanned in the database of the "Web of Science." The database of the Web of Science (WOS) provides access to citation statistics of scientific publications and bibliographic data of publications (Meho and Yang, 2007). In the "Web of Science Core Collection" Database, the publication types, titles, author names, number of citations and sources of 504 studies published in the topic of the "tomato production" in the database of "Web of Science" were accessed. This analysis was carried out by uploading the data to the R Programme in the appropriate format.

It was Alan Pritchard who coined the word "bibliometrics" in 1969. According to Pritchard, bibliometrics is the study of written communication via the use of statistical and mathematical techniques in order to inform both the evolution of a field and its procedures (Lawani, 1981). Innovative bibliometric research goes all the way back to the turn of the 20th century. Cole and Eales were among the first scientists to use bibliometric analysis to identify the present state of study topics in 1917 after reviewing the works on the history of comparative anatomy published between 1550 and 1860 (Okubo, 1997).

According to Pritchard (1969) and Evren and Kozak (2012), bibliometrics is the study of scientific information-sharing resources such published books, journals, and articles using statistical and mathematical techniques. The foundation of bibliometric research is the analysis of specific document or publishing features to provide a range of conclusions on scientific communication (Al and Coştur, 2007).

Bibliometric approaches are being utilized more and more in many disciplines nowadays to map the collaboration between scientific investigations and to identify broad patterns connected to a certain study subject or discipline/field (Börner et al., 2003; Župič and Čater, 2015).

Research themes, trends, and interests may be reviewed with the use of keyword analysis, which can serve as a roadmap for further study (Leung et al., 2017).

III. RESULTS

The basic information obtained in the field of wrestling sports is given in Table 1.

Table 1. Basic Information about Publications

Description	Results
MAIN INFORMATION ABOUT DATA	
Timespan	1992:2023
Sources (Journals, Books, etc.)	138
Documents	504
Annual Growth Rate %	11,08
Document Average Age	6,59
Average citations per doc	0
References	1
DOCUMENT CONTENTS	
Keywords Plus (ID)	763
Author's Keywords (DE)	1217
AUTHORS	
Authors	2424
Authors of single-authored docs	6
AUTHORS COLLABORATION	

Single-authored docs	6
Co-Authors per Doc	5,97
International co-authorships %	0
DOCUMENT TYPES	
Case reports	1
Comparative study	9
Evaluation study	11
Historical article	1
Journal article	481
Review	1

As seen in Table 1, a total of 504 works have been published on this subject, of which 481 are journal articles, and the rest are Comparative study, papers, clinical studies, case reports, etc. The distribution of the number of publications by years is presented in Figure 1.

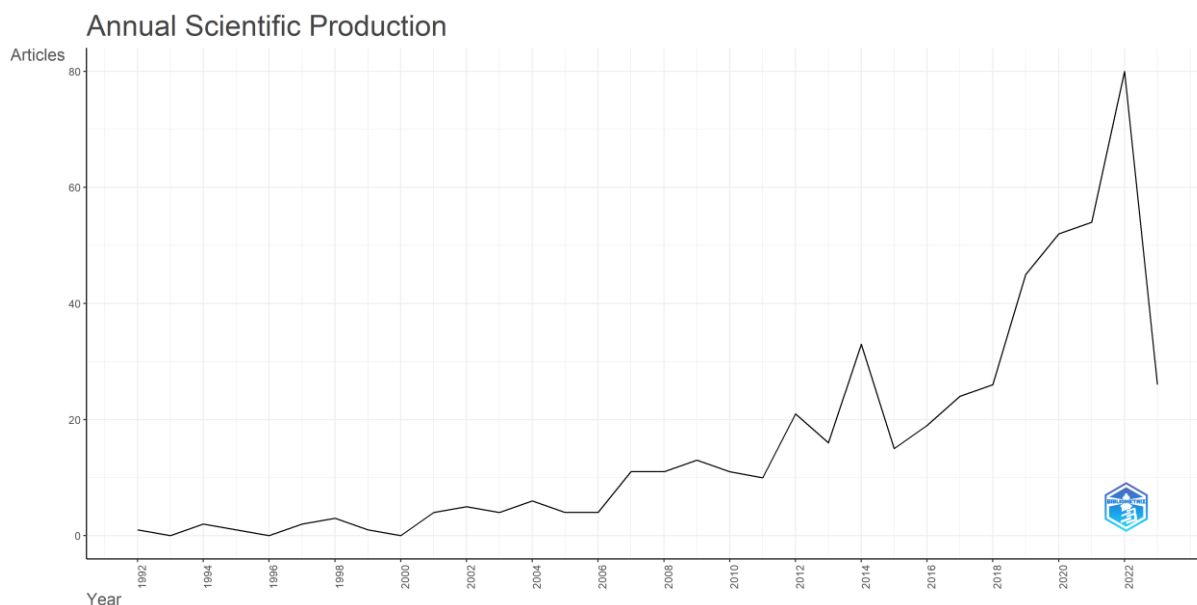


Figure 1. Number of Publications by Years

When Figure 1 was examined, the highest number of publications were recorded in 2022, 2021, and 2020, respectively. The number of articles belonging to these years are 80, 54, and 52, respectively. The list of journals in which studies directly related to the subject are published is shown in Table 2 and Figure 2. The journal with the highest number of articles published in the field of tomato production is the Plant Disease, with a total of 74 articles. This is followed by Plants (Basel, Switzerland), with a total of 27 articles, and Phytopathology, with a total of 24 articles.

Table 2. Number of Most Relevant Publications

Sources	Articles
Plant Disease	74
Plants (Basel, Switzerland)	27
Phytopathology	24
Plos One	23
Journal of Economic Entomology	21
Frontiers in Plant Science	17

Archives of Virology	14
Frontiers in Microbiology	14
Scientific Reports	14
Pest Management Science	12

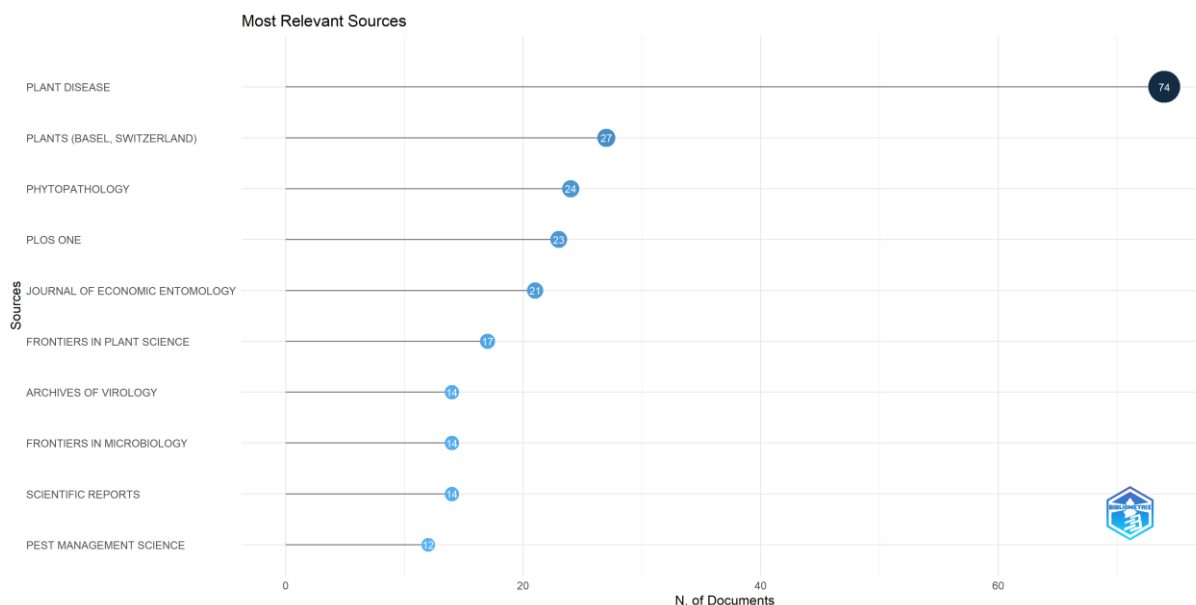


Figure 2. Publications with the Most Relevant References

The number of publications of the authors during the relevant period is presented in Table 3. LiY is the author with the most publications on wrestling matches, with a total of 13 articles. Chen X was followed by Kerry ZY with a total of 11 articles, and Jones JB, Li J, Miller SA, Vallad GE and Wang J with 10 articles each. These publications are covering the period from 1992 to 2023. Additionally, there have been more comprehensive publications between 2015 and 2023. Figure 3 provides a more clear view of this data.

Table 3. Authors with the Most Publications

Authors	Articles	Articles Fractionalized
Li Y	13	1,99
Chen X	11	1,21
Jones JB	10	1,59
Li J	10	1,14
Miller SA	10	1,78
Vallad GE	10	1,79
Wang J	10	1,59
Wang H	9	1,41
Wang X	9	1,83
Gilbertson RL	8	2,07
Liu X	8	1,04
Zhang Y	8	0,92

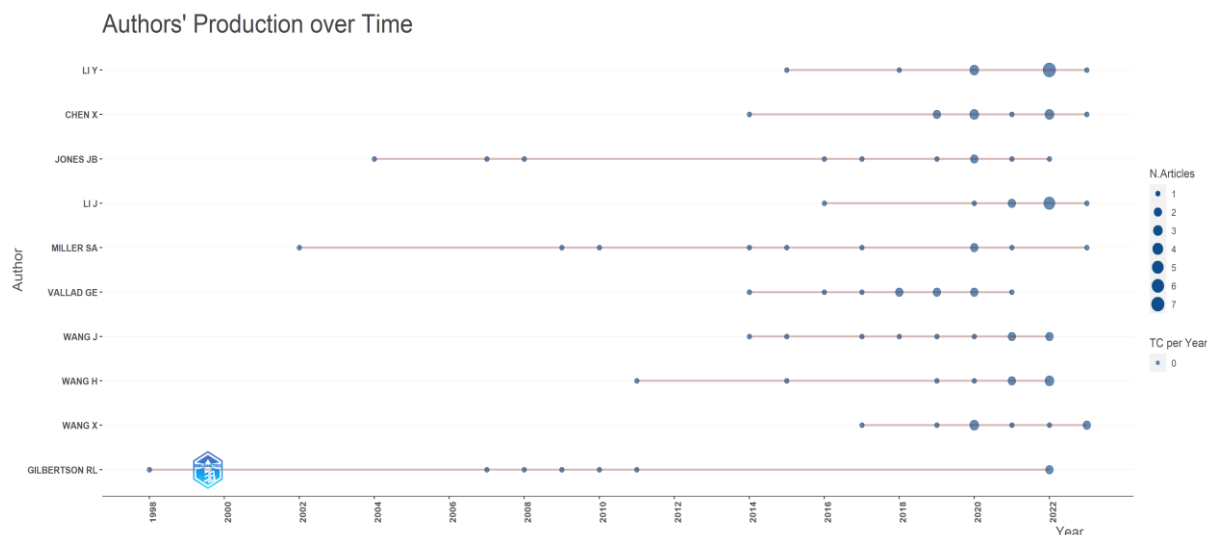


Figure 3. Authors' production over time

As a result of the Web of Science-based search, the most frequently used keywords in the journals included in the SCI-Exp. Indexes are presented in Table 4 and Figure 4. The most frequently used words are solanumlycopersicum(264 times), plantdiseases (141 times), and animals (82 times).

Table 4. Most Frequent Words

Words	Occurrences
Solanumlycopersicum	264
Plantdiseases	141
Animals	82
Begomovirus	47
Phylogeny	41
Plantleaves	39
Hemiptera	34
Agriculture	31
Fruit	26
Soil	25

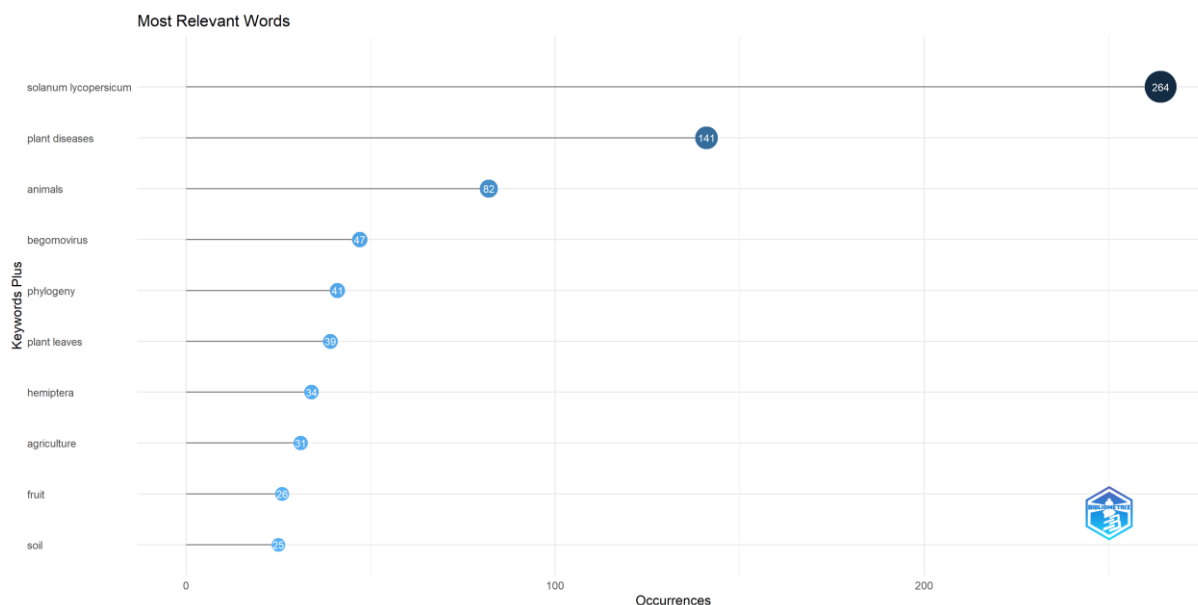


Figure 4. Most relevant words

Tree map analysis was conducted for the most used keywords, and the results of its analysis are presented in Figure 5. It was observed that most of the words were specific to the related field. The most commonly used keyword was "solanumlycopersicum"(21%). "Plantdiseases" (%11) was the second most commonly used keyword. These most used word was followed by "animals" (%7).



Figure 5. Tree Map

The collaboration map between the words used in published studies is presented in Figure 6.

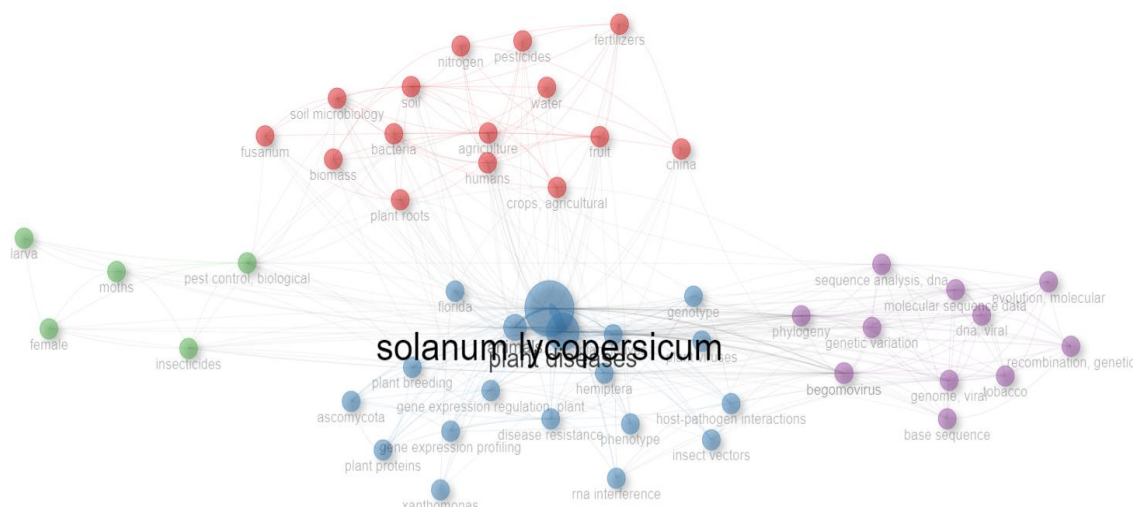


Figure 6. Collaboration occurrence network (keywords)

The most intensively studied topics were in the blue-colored cluster, and these topics were on *solanum lycopersicum*, plant diseases and animals. This was followed by genetic variation, begomovirus, phylogeny and base swquence in the purple cluster. Molecular sequence, DNA viral and sequence analysis, DNA are other topics. Crops agricultural, plant roots, biomass and fusarium in the red cluster have also been the most studied topics. In the green cluster, insecticides, pest control biological, moths and larvae were the most studied topics (Figure 6). The representation of subject densities is presented in Figure 7.

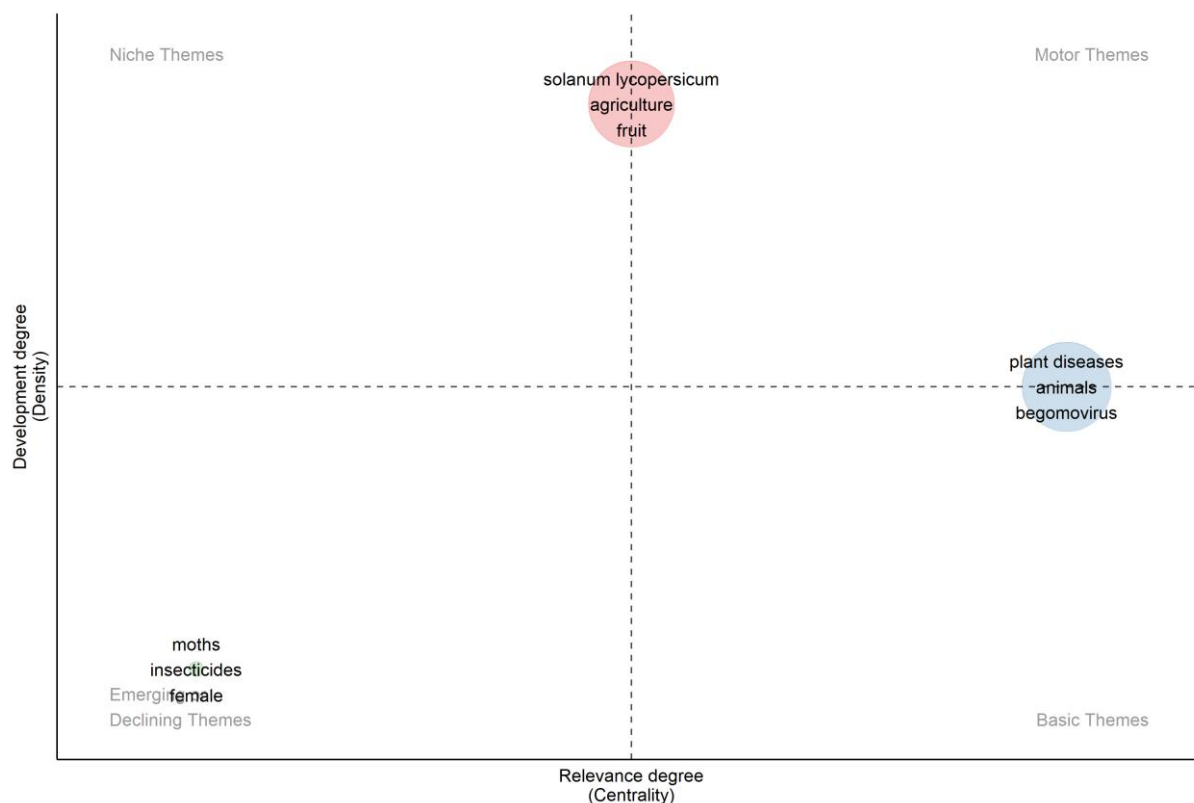


Figure 7. Thematic Map

When the thematic map shown in Figure 7 is analysed, ‘plant disease’, ‘animals’ and ‘begomovirus’ topics are clustered in the motor theme. These topics also had a relationship with the basic theme. The topics ‘Solanumlycopersicum’, ‘agriculture’ and ‘fruit’ were clustered both in the motor theme and in the niche theme. By analyzing trend topics, we can observe how keywords, titles, and abstracts have evolved over time and how they have become essential components in the growth of research in any field (Figure 8). In order to monitor changes, terms in a coordinate plane are given logarithmic frequency values using trend topics analysis.

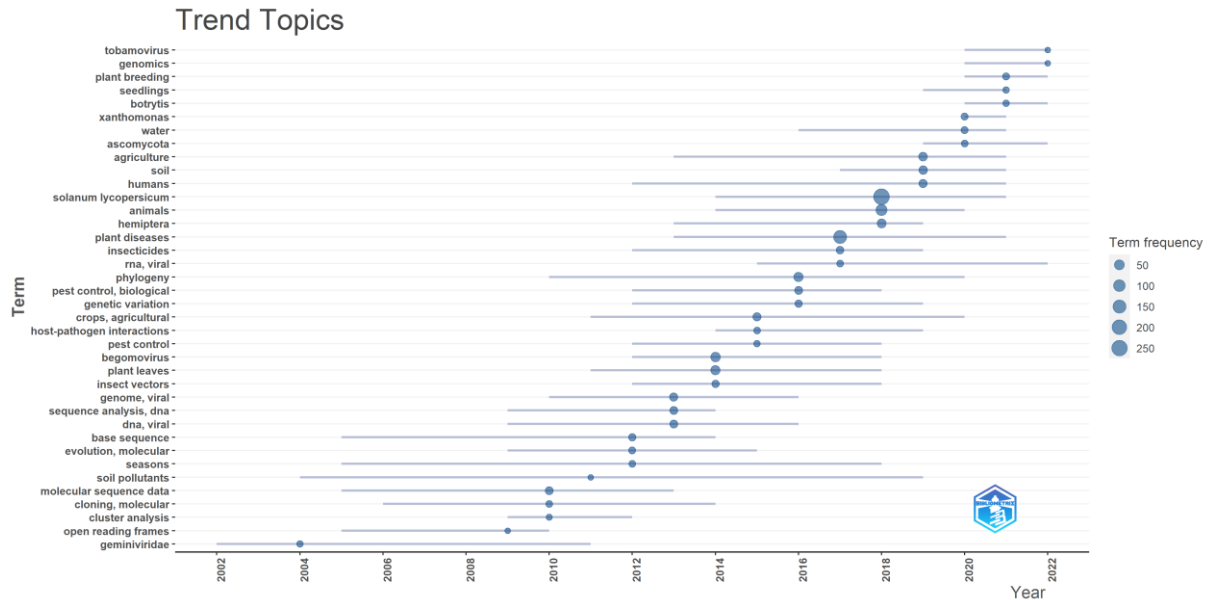


Figure 8. Trend topics of the field

The trends of tomato production topic studies were investigated using Figure 8, which was created to show the information such as abstract, keyword, and title of the three keywords that were cited at least three times each year between 2002 and 2022. In the research conducted in recent years, keywords have been regularly included. *Solanum lycopersicum*, plant diseases, animals, plant leaves, hemiptera, agriculture and soil retained their attractiveness.

IV. CONCLUSION

The objective of this study was to enlighten the route of marketing practitioners and professionals regarding tomato production, by generating a broad picture of done research and proposing guidelines for future studies. Actually, the current study applied bibliometric analyses to review 504 articles which were indexed in web of science in order to explore the number of published articles, main journals for tomato plant, co-authorship, and used keywords. 1217 keywords in all were extracted from the selected 504 articles. The most often used term was "*Solanum lycopersicum*" (264), which was followed by "plant diseases" (141), "animals" (82), "begomovirus" (47), "phylogeny" (41) and "plant leaves" (39). This evidence suggests that bibliometric analysis studies can significantly benefit from wider adoption as a guide for agricultural research.

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