

Colletotrichum Gloeosporioides and its Hosts: A Scientometric Analysis

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ABSTRACT

Objective: To carry out a scientometric analysis of published articles that report the occurrence of the fungus Colletotrichum gloeosporioides from 11 different fruits.

Place and Duration of Study: The study was carried out at Department of Agronomy, State University of Goiás, Ipameri University, Brazil and Department of Botany, Islamia College Peshawar, Pakistan from December 2019 to February 2020.

Materials and Methods: For the development of this study, specialized searches were made on the "Web of Science" database using keywords e.g the scientific names of the plant species affected by the pathogen *C. gloeosporioides*.

Results: Total 241 articles were published during 2000 to 2020. The *M. indica* L., *C. Papaya* and *P. Americana* found to have the largest number of published works and also citations. Regarding the relationship between citations/article, the highest citation per article were recorded for *Ficus carica* (average of 46.00 citations / article), followed by *Diospyros kaki* (average of 17.50 citations / article), *Pyrus* spp. (average 16.00 citations / article) and *Carica papaya* (average 15.38 citations / article). A total of 116 journals were responsible for the published works, 10 of which concentrated 37% of the total articles.

Conclusion: This study concluded that the largest number of articles has been published in the world literature that relate the occurrence of *C. gloeosporioides* on *M. indica* and *C. papaya*. Further studies on anthracnose in some plant species are needed, due to the low rate of publications and citations.

Introduction

Anthracnose is a fungal disease, caused by Colletotrichum gloeosporioides is one of the most destructive diseases in the pre and post-harvest phases that occur with greater incidence in the subtropical and tropical regions of the world, generating great economic losses for farmers [1,2]. *C. gloeosporioides* is capable of infecting at least 1,000 hosts, including the main commercial fruit species such as papaya, mango, guava and avocado [3]. However, the effects of the environment can intervene in the development of pathogens, thus, knowledge of environmental variations can contribute to disease management strategies [4,5]. The development of *C. gloeosporioides* occurs due to high temperature and relative

humidity, where the conidia are released and disseminated at that moment when the clots are moist. The germination take place in the presence of water. After germination, give rise to appressorium where penetration occurs in the host's tissue [6]. The pathogen can attack different parts of the plant, such as branches, leaves, inflorescences, pseudofruit and nuts [7]. For the control of the disease, it is common to apply pesticides, mainly fungicides, but with the increase in damage to the environment, health and resistance of phytopathogens, new alternatives have progressed, such as the use of natural products that have been studied with the purpose of reducing the damage caused by this fungus [8].

Fruit growing is one of the most important segments in Brazilian agriculture, being the third largest fruit producer, occupying an area of 2,300 million hectares and a production of 38.8 million tons in the 2016 harvest [9,10]. This is due to better management of rural properties, modernization and other factors aimed at safety, quality of fruits and preservation of the environment, thus meeting the requirements of the Brazilian market and importing countries [11]. Even with investment by the fruit grower, the incidence of diseases in the orchards is still recurrent. High humidity and high temperature are the main factors that contribute to the development of the pathogen influencing the productivity of different cultures [12]. Among the crops that can be damaged by the fungus *C. gloeosporioides* is the mango tree, because of it, had a great impact on its production, these damages being directly related to the decrease in the post-harvest life of the fruit [13]. In papaya, the fungus causes peduncular rot, causing losses during commercialization [8]. Another crop avocado, that can also be damaged by the pathogen, where its ripening in high susceptibility generates the invasion of the fungus, due to the reduction of phenolic components and due to the softening of the fruits [14]. Other characteristic symptoms of the disease are the spots, among them the glomerella leaf spot in the apple tree culture, which is initially characterized by color spots that can vary from red to purple and days after infection it becomes an irregularly shaped necrotic spot [15].

In guava, the symptoms are known for rounded and dark colored lesions that become depressive with the growth of size [16]. In cashew, the pathogen is considered one of the most severe diseases in Brazil and is characterized by numerous injuries that can occur on fruits, flowers, leaves, branches and peduncles [17]. However, there are still several cultures to be studied more in-depth studies, including pomegranate, persimmon, fig and cupuaçu tree, with little information and publications that relate these cultures in relation to the pathogen on their epidemiological and symptomatological form [18-20]. Through scientometrics it is possible to carry out metric

studies of information, which was started in the 1960s under the influence of the Sociology of Science [21]. Its main purpose is to analyze scientific productions with validated information through statistical analysis and numerical indicators [22]. Therefore, this tool is important to evaluate scientific productions in a specific niche of knowledge [23]. Among the various scientific institutions, the Institute of Scientific Information (ISI) which was developed during 1958-1960 with the purpose of making recent and quality information available to its readers [24]. The Web of Science has better and more detailed graphics, when compared to other platforms such as Scopus [25]. Therefore, it is considered the most rigorous and important index that covers all areas of knowledge [26]. In this sense, the objective of the work was to carry out a scientometric analysis of published articles that report the occurrence of the fungus *C. gloeosporioides* from 11 different fruits. For the development of this study, specialized searches were made on the "Web of Science" database by using the scientific names as a keyword for the cultures affected by the pathogen.

Methods

To conduct this study, specialized searches were carried out individually in the "Web of Science" database, using the following keywords: *Mangifera indica* L., *Carica papaya*, *Persea americana*, *Malus domestica*, *Psidium guajava*, *Anacardium occidentale*, *Punica granatum*, *Pyrus spp.*, *Diospyros kaki*, *Ficus carica* and *Theobroma grandiflorum*, along with the pathogen's name: *Colletotrichum gloeosporioides*. For each plant species associated with the pathogen, the following information was identified: the year of publication, publication periodic and the number of citations. The data obtained were submitted to descriptive statistics for the variables: number of articles published by culture, the number of citations for the total number of articles published for each culture and the 10 journals that presented the largest number of published scientific articles.

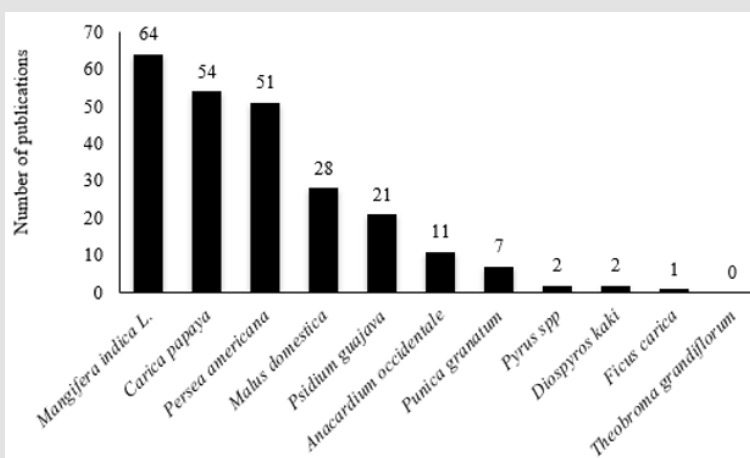


Figure 1: Number of articles for each of the eleven cultures chosen, affected by the pathogen *Colletotrichum gloeosporioides*, indexed in the Web of Science database, between the year 2000 and 2020.

In the general search, 241 articles indexed in the Web of Science database were obtained. The filtrations cultures were carried out, 64 studies were carried out on *M. indica L.*, 54 on *C. papaya*, 51 on *P. americana*, on the other hand, for *M. domestica* there were 28, 21 for *P. guajava*, 11 on *A. occidentale*, 7 for *P. granatum*, the pathogens *Pyrus spp.* and *Diospyros kaki* were 2 and 1 for *Ficus carica* and there was no publication indexed in the database for *Theobroma grandiflorum* (Figure 1). The culture *M. indica L.* corresponded to 26% of the articles collected and correlated with anthracnose. This large amount of results related to this crop in relation to the others, the cultivation of mango is on wide spectrum in the national territory, whether in commercial orchards of the irrigated poles from Petrolina to Juazeiro, or on a domestic scale, in addition to the ease of propagation, handling and the high yield of fruits makes this fruit an attractive species [27]. The presence of anthracnose in the mango tree is due to the favorable climatic conditions for its development found in most of the Brazilian territory. One of the factors that has favored the increase in investigations involving this pathogen is the damage caused to the sleeve, which has effectively contributed to the number of publications and consequently to citations in new research on the subject [28-31].

Total eleven plant species were chosen from the citations obtained by the articles, it was found that three obtained the highest number of citations such as *C. papaya*, *M. indica L.* and *P. americana* (Figure 2). However, the plant species that presented the highest ratio of average number of citations / articles were *F. carica* (average of 46.00 citations / article), *D. kaki* (average of 17.50 citations / article), *Pyrus spp.* (average 16.00 citations / article) and *C. papaya* (average 15.38 citations / article). All other plant species had a ratio of less than 10.78 citations / article, and *T. grandiflorum*

did not get any citations. Thus, *M. indica L.* is the specie with the highest number of published articles, however, it did not present the highest total number of citations. Although, papaya presented the highest total number of citations, it can be explained by the fact that it is the second crop with the highest total number of publications. In spite of this, two other plant species that presented the great relation of average number of citations / articles: *Ficus carica* and *Diospyros kaki*. Regarding the average number of citations / articles, *Ficus carica* species had the highest average citation, this can be explained by the lack of work that relates species to the pathogen and the fact that studies on this pathogen have high economic interest, as anthracnose does not attack only *F. carica* and yes several botanical families, attacking mainly on the fruits, that is the part of economic interest [31]. Soon after, *Diospyros kaki* presented a high average number of citations / articles, however, it is among the three cultures that presented the lowest number of publications. However, the fact of presenting a high number of citations / articles, which may be related, according to Blood et al. [32], due to the scarcity of studies related to the development of the disease in the field and in post-harvest, making production difficult of the plant. About 116 journals were responsible for the 241 published and indexed works on the Web of Science database. Among the magazines with the highest number of publications were *Acta Horticulturae* (24 articles), *Revista Brasileira de Fruticultura* (11 articles), *Postharvest Biology and Technology* (10 articles), *Crop Protection* (9 articles), *Scientia Horticulturae* (8 articles), *Tropical Plant Pathology*, *Biological Control* (6 articles) and *Plant Disease*, *Journal of Phytopathology* and *European Journal of Plant Pathology* (5 articles) the other journals had less than 4 publications (Figure 3).

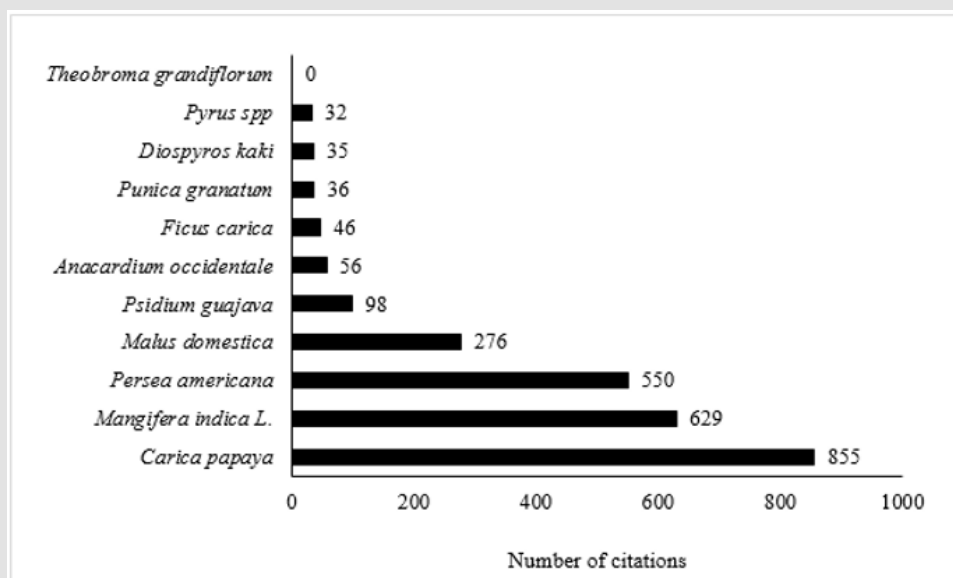


Figure 2: Absolute frequency of citations obtained by articles published for each of the eleven cultures chosen, affected by the pathogen *Colletotrichum gloeosporioides*, indexed in the Web of Science database, in the range between 2000 and 2020.

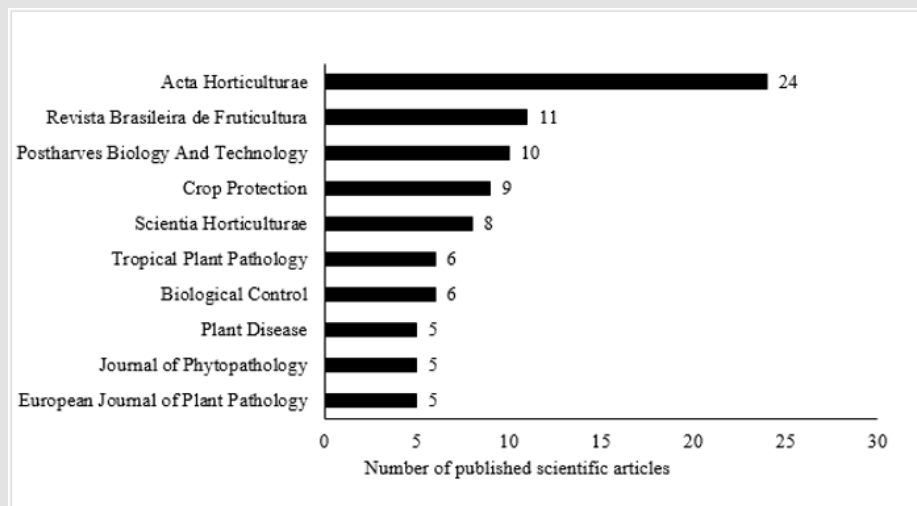


Figure 3: List of the journals that most published on the eleven chosen cultures, affected by the pathogen *Colletotrichum gloeosporioides*, according to a survey in the Web of Science database, between 2000 and 2020.

Ten journals concentrated 37% of the total published scientific work on fruitful hosts of anthracnose. However, the journals *Acta Horticulturae*, *Revista Brasileira de Fruticultura* and *Postharvest Biology and Technology* deserve to be highlighted due to the fact that they include fruitculture in their scopes, despite the fact that *Postharvest Biology and Technology* makes publications on other areas, such as bioinformatics, entomology, plant physiology and plant pathology etc.

Conclusion

The highest number of published work regarding the citation/article stood out for *C. papaya* related to anthracnose, while the highest average ratio of citations / scientific article was found for *F. carica*. Total ten journals were responsible for 37% of the scientific articles published on the fruit hosts of *C. gloeosporioides*.

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