Original Research Article

Scientometric analysis of the main Eucalyptus diseases

ABSTRACT

Diseases are considered one of the main factors that limit the productivity of the Eucalyptus sp. Thus, the objective was to carry out a scientometric analysis of the articles, focusing on the eleven main pathogens that affect the eucalyptus culture. For the development of this study, specialized searches were carried out on the "Web of Science" database using the scientific names of pathogens and eucalyptus as key words. In the general search, a result of 123 articles published between 2000 and 2020 was obtained, with *Mycosphaerella* spp., *Ceratocystis fimbriata*, *Botryosphaeria ribis* and *Cylindrocladium* spp., The pathogens with the highest number of published works and also citations. Regarding the citations / article, *Botryosphaeria ribis* (average of 68.80 citations / article), *Mycosphaerella* spp (average of 34.57 citations / article) and *Cylindrocladium* spp. (average of 27.12 citations / article). Regarding the journals, a total of 38 journals were responsible for the published works, with nine of them concentrating 60% of the total of published articles.

Keywords: Silviculture, phytopathology, scientometrics, forest pathology.

1. INTRODUCTION

Eucalyptus (*Eucalyptus* spp.), is a plant of Australian origin, belonging to the Myrtaceae family and has around 600 species [4]. Currently, species belonging to the genus *Eucalyptus* are the most used in reforestation programs, dominating an area of more than 5.7 million hectares [9]. Eucalyptus planting is a highlight in Brazil, because in addition to generating economic benefits in the production of energy, cellulose, paper, roundwood and essential oils, it also provides environmental advantages such as, improving air quality and recovering degraded areas [19]. Several factors limit crop productivity, among which diseases stand out [15]. Among the main incident pathogens can be mentioned, the fungus *Ceratocystis fimbriata*, which penetrates the plant through an insect vector or through wounds through roots causing significant economic losses [17].

The fungi *Cylindrocladium candelabrum* and *Mycosphaerella* spp. that cause staining and paralysis of plant growth, defoliation and consequently reduction of the photosynthetic area [11]. Fungi, *Cryphonectria cubensis*, on the other hand, are known to reduce productivity and energy quality of damaged wood [2] and the fungus *Botryosphaeria ribis* forms cancers and pointer drought [8]. In the group of bacteria, *Ralstonia* spp. Can be mentioned, which causes wilt and necrosis in the central part of the leaf veins [2]. The fungus *Puccinia psidii*, popularly known as rust, mainly attacks the sprouts of seedlings and young eucalyptus trees, causing losses of up to 30% in the annual development of the crop, the pathogens *Botrytis* spp. and *Rhizoctonia* spp., which occur with a higher incidence of seedlings, causing damage in commercial nurseries causing toppling and the fungus *Oidium eucalypti*, which is characterized by excessive sprouting and distorted leaves, seedlings die [6]. The database (Institute of Scientific Information - ISI) was developed between 1958 to 1960 with the purpose of providing quality and recent information to researchers [20]. In addition, it is seen as the

most important basis for making articles available in all areas of knowledge [16]. Cienciometry is based on quantitative scientific research, being intended to measure the productivity and production of a certain branch of knowledge, with the main objective of knowing and exposing the development of any area [5]. It emerged in the late 1970s in Hungary as "Scientometrics", but after ten years, there was the greatest interest due to the development of a database known as the Institute for Scientific Information [3]. In this sense, scientometrics covers much more than characteristics of processing and information, but it also certifies the properties, theories and history of information [12]. Thus, the objective was to collect articles on the eleven main pathogens of eucalyptus culture published on the ISI Web of Science platform, as well as their respective journals and metrics, between 2000 and 2020.

2. MATERIAL AND METHODS

For the execution of this study, specialized searches were made in the "Web of Science" database with the following keywords: *Ceratocystis fimbriata, Cylindrocladium* spp., *Mycosphaerella* spp., *Cryphonectria cubensis, Botryosphaeria ribis, Ralstonia* spp., *Rhizoctonia* spp., *Puccinia psidii , Colletotrichum gloeosporioides, Botrytis* spp. and *Oidium eucalypti*, all of which are added to the host culture name: *Eucalyptus* spp. For each article, the following were identified: the year of publication, the publication periodical and the number of citations.

Based on the data obtained, column charts were made for comparisons: number of articles published by pathogen, the number of citations for the total number of articles published for each pathogen and the 9 journals with the highest number of published scientific articles.

3. RESULTS AND DISCUSSION

3.1 Results

After the search, 123 articles indexed in the Web of Science database were obtained. After filtering by pathogens, 35 works were carried out on *C. fimbriata*, 23 for *Mycoscphaerella* spp., 17 for *Cylindrocladium* sp., 11 for *C. cubensis*, 10 on *B. ribis*, 9 on *Ralstonia* spp., 6 on *Rhizoctonia* spp. and *P. psidii*, 3 for *C. gloeosporioides*, 2 for *Botrytis* and 1 for *O. eucalypti*, (Figure 1).

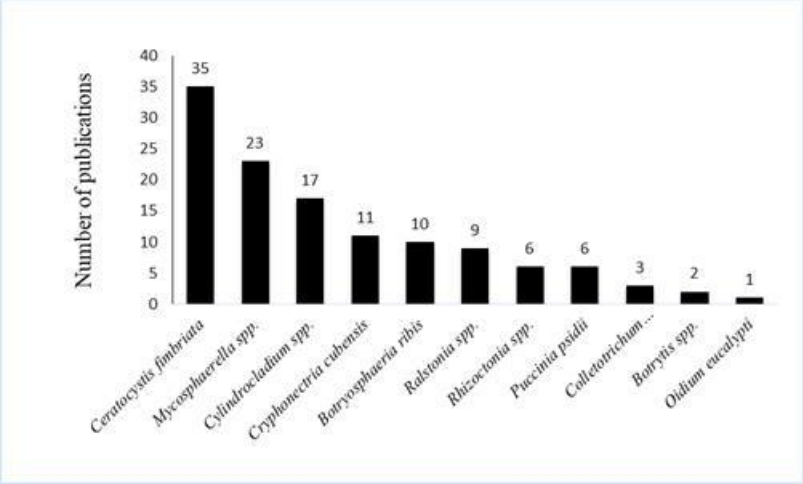

Fig. 1. Number of articles for each of the eleven main pathogens of the *Eucalyptus* spp. Culture, indexed in the Web of Science database, comprising the interval between 2000 and 2020.

Regarding the citations obtained by the articles, it is noted that the 4 pathogens with the highest number of citations were *Mycosphaerella* spp., *C. fimbriata, B. ribis* and *Cylindrocladium* spp., as shown (Figure 2). Therefore, it was already expected that these pathogens would obtain the highest average number of citations / article, due to the fact that they present the largest number of publications, presenting *B. ribis* (average of 68.80 citations / article), *Mycosphaerella* spp. (average of 34.57 citations / article) and *Cylindrocladium* spp. (average of 27.12 citations / article). The other pathogens obtained an average lower than 22.50 citations / article.

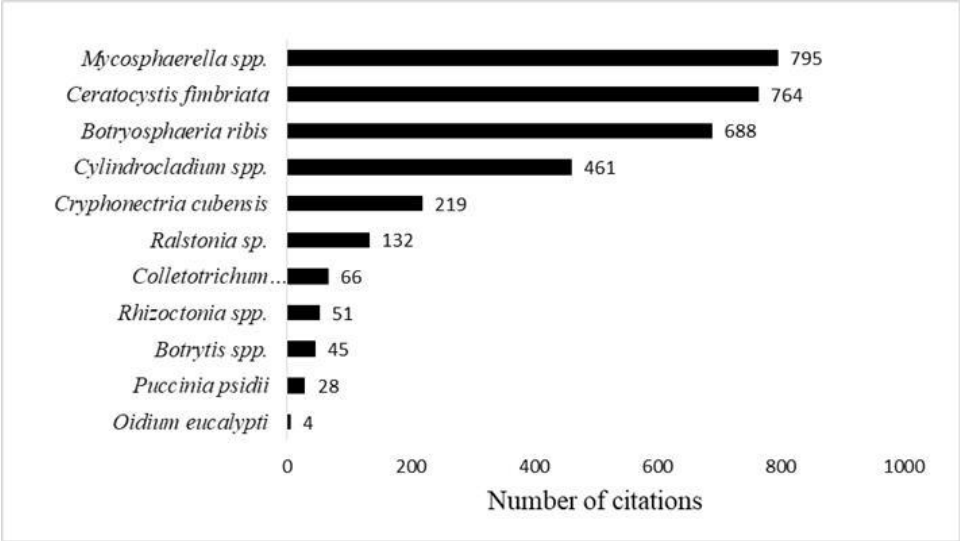

Fig. 2. Number of citations obtained by articles published for each pathogen occurring in the *Eucalyptus* spp. Culture, according to a survey in the Web of Science database, covering the interval between 2000 and 2020.

A total of 38 journals were responsible for the 123 published works. Among the journals that stood out the most for the largest number of publications are: Fungal Diversity (15 articles), Australasian Plant Pathology (12 articles), Persoonia (10 articles), Studies in Mycology (8 articles), Mycologia and Mycological Research (7 articles) and Tropical Plant Pathology, Forest Pathology and Plant Pathology (5 articles), the other journals had less than 4 publications (figure 3).

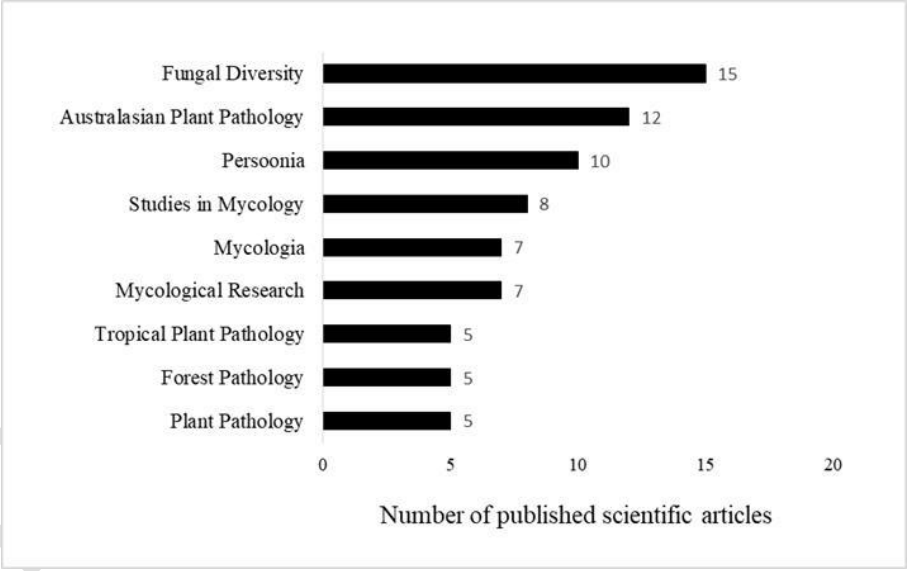

Fig. 3. List of the journals that most published on diseases of the *Eucalyptus* spp. Culture, according to a survey in the Web of Science database, covering the interval between 2000 and 2020.

3.2. Discussion

The fungus *Ceratocistys fimbriata*, which causes Ceratocystis wilting disease, corresponded to 35% of the surveyed articles. There is a greater quantity of articles related to this pathogen, which can be explained by the fact that it is one of the most important diseases of *Eucalyptus* spp. in Brazil, being that it is distributed among different places in the world, it still attacks different cultures and being transmitted by the soil, which further increases its incidence [10].

It is a pathogen that colonizes the xylem, the radial parenchyma, eventually darkening the infected tissues and causing the entire plant or individual branches to wilt and die. Therefore, the *Eucalyptus* spp. they can be infected through their roots by inoculation in the soil, through fresh wounds by conidia or ascospores on tools or insects, they can be dispersed in the air or rain. In addition, the dissemination facilitated by man and the dispersion over relatively short distances [1].

After what was exposed, and the damage that this pathogen causes in the production of Eucalyptus spp., does causes an increasing number of studies with the pathogen, both in the number of publications and the number of citations. Thus, in summary, *C. fimbriata* is the pathogen with the highest number of published articles, however, it was not the pathogen that had the highest number of citations, being in second place with the highest number of citations. In contrast, the pathogens that stood out with the highest average number of citations / article were *B. ribis* and *Mycosphaerella* spp.

The pathogen *B. ribis* showed a higher ratio of average number of citations / article, and it was expected, in the end *B. ribis* is the causative agent of the main disease of the *Eucalyptus* spp. culture. This species of fungus is associated with *Eucalyptus* spp. has been characterized in different countries, such as Congo, Uganda, Chile, Australia, South Africa, Ethiopia, Venezuela, Colombia, Uruguay and China [13-14-7]. On the contrary, *O. eucalypti* was the one with the lowest number of publications and citations, therefore the lowest average number of citations / article. A possible explanation is the fact that it is a biotrophic fungus that will rarely cause damage to its hosts [18] and will not attract the attention of scientists, making it impossible for results related to *Eucalyptus* spp. and *O. eucalypti*.

A total of 9 journals concentrate 60% of the total of articles published on the main diseases of *Eucalyptus* spp., Worthy of mention are the journals Fungal Diversity, Australasian Plant Pathology and Persoonia deserve to be highlighted, as they include phytopathology in their scope, in addition to publishing on taxonomy, molecular systematics and evolution of fungi.

4. CONCLUSION

The pathogen with the highest number of articles published in the culture of *Eucalyptus* spp. It is Ceratocystis fimbriata, however the pathogen with the highest average ratio of citations / scientific article is *Botryosphaeria ribis*.

A total of nine journals concentrate 60% of the total scientific articles published on diseases in the culture of *Eucalyptus* spp., when consulted on the web of science database.

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