Analysis and Visualisation of Research Trends in Aphanomyces Root Rot: A General Review

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Abstract

Aphanomyces root rot disease (**Aphanomyces euteiches**) *is a fungal infection caused by oomycetes fungi. The bibliometric analysis had been conducted to understand the active authors, organizations, journals, and countries involved in the research domain of "Aphanomyces root rot". All published articles related to "Aphanomyces root rot" from "Scopus", were analyzed using the VOS viewer to develop analysis tables and visualization maps. This article had set the objective to consolidate the scientific literature regarding the "Aphanomyces root rot" and also to find out the trends related to the same. The most active journals in this research domain were identified as Plant Disease and Plant Molecular Biology. The most active countries were the United States of America and Poland. The leading organizations engaged in the research regarding Aphanomyces root rot was the United States Department of Agriculture of the USA. The most active authors who had made valuable contributions related to Aphanomyces root rot disease was Baranger A.*

Keywords: Aphanomyces root rot, Bibliometric analysis, VOS viewer, Plant disease

1. Introduction

Aphanomyces root rot disease (*Aphanomyces euteiches)* is a fungal infection caused by *oomycetes fungi*. This fungus is present and highly active in wet and poorly drained soil[1]. This disease shows the symptoms of roots appear grey, water-soaked, and finally decay of roots; stunting and death of seedlings; and yellowing of plants[2-3]. The major hosts of this disease are pea, alfalfa, snap bean, red kidney bean, faba bean, red clover, white clover, and lentil[3]. The management measures to prevent this disease include the use of resistant cultivars, ensuring proper soil drainage, crop rotation, improving calcium content in soil[3]. Strong resistant variants are yet to be developed rigorous research is required regarding this plant disease.

1.1 Research Objectives

    a) To consolidate the literature regarding the Aphanomyces root rot
    b) To find out the trends related to research in the Aphanomyces root rot

The following research questions are framed for conducting bibliometric analysis systematically.

1.2 Research Questions

  a) Who are the active researchers working on the Aphanomyces root rot?
  b) Which are the main organizations and countries working on Aphanomyces root rot?
  c) Which are the main journals related to Aphanomyces root rot?

1.3 Significance of this research

Aphanomyces root rot is a serious plant disease having both ecological and economic effects. This article points out the need for future research regarding the plant disease, Aphanomyces root rot. This bibliometric analysis will be a useful platform for future researchers by realizing the top researchers, organizations, and countries involved in managing Aphanomyces root rot disease. This bibliometric article is arranged in four sections. The first section is the introduction, followed by the discussion of the methodology by which the research was conducted. The third section deals with results and discussion. The fourth section deals with the conclusion.

2. Research Methodology

This bibliometric analysis had drawn resources only from the Scopus, which is having coverage of more than 69million records. For the article selection, the Boolean used was TITLE-ABS ("Aphanomyces root rot") on 26/12/2020. All the tables in this paper were created by using Microsoft Excel and VOS Viewer. Grammarly was used for spelling and grammar checks. Mendeley was used for article review and citation. This paper had been inspired by bibliometric analysis in its presentation style, analysis, and methodology from the works.[4-8]

3. Results and discussion

3.1 Results

This first round of search produced an outcome of 187 documents, in five languages, out of which 181 documents were in English. The classification of document categories is shown in Figure 1. For improving the quality of the analysis, we had selected only the peer-reviewed articles and all other documents had not been considered. Thus after using filters "Article" and "English" the second round search produced an outcome of 166 English articles (both open access and others) and had been used to conduct bibliometric analysis and visualization using VOS Viewer. The English research articles in this domain since 1961 had been shown in Figure 2.
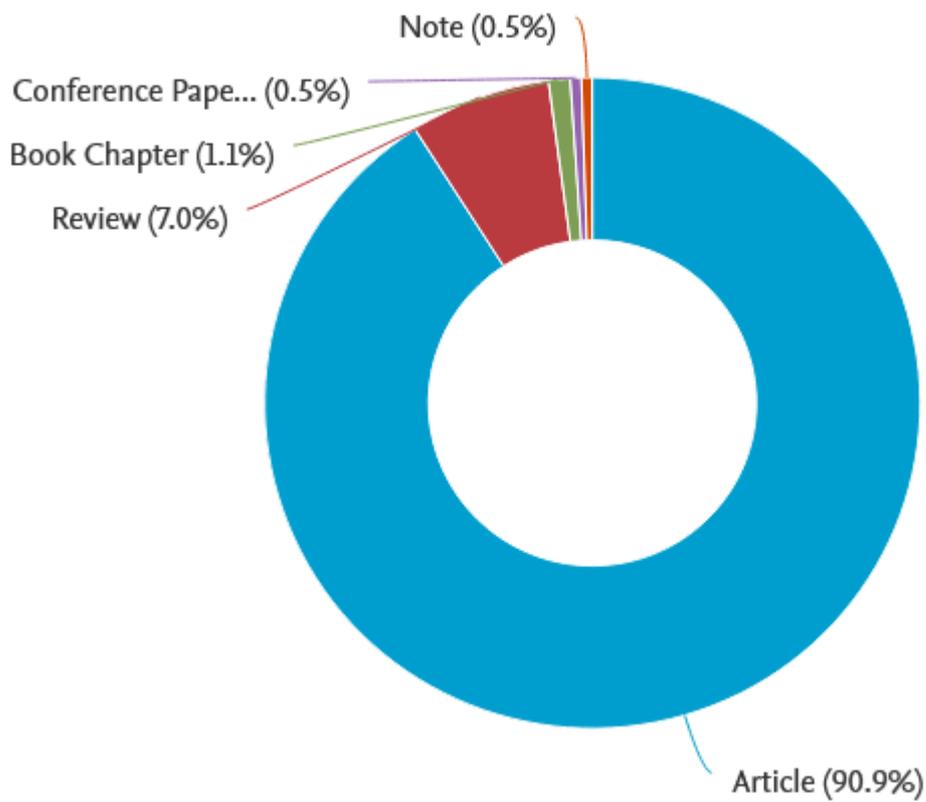
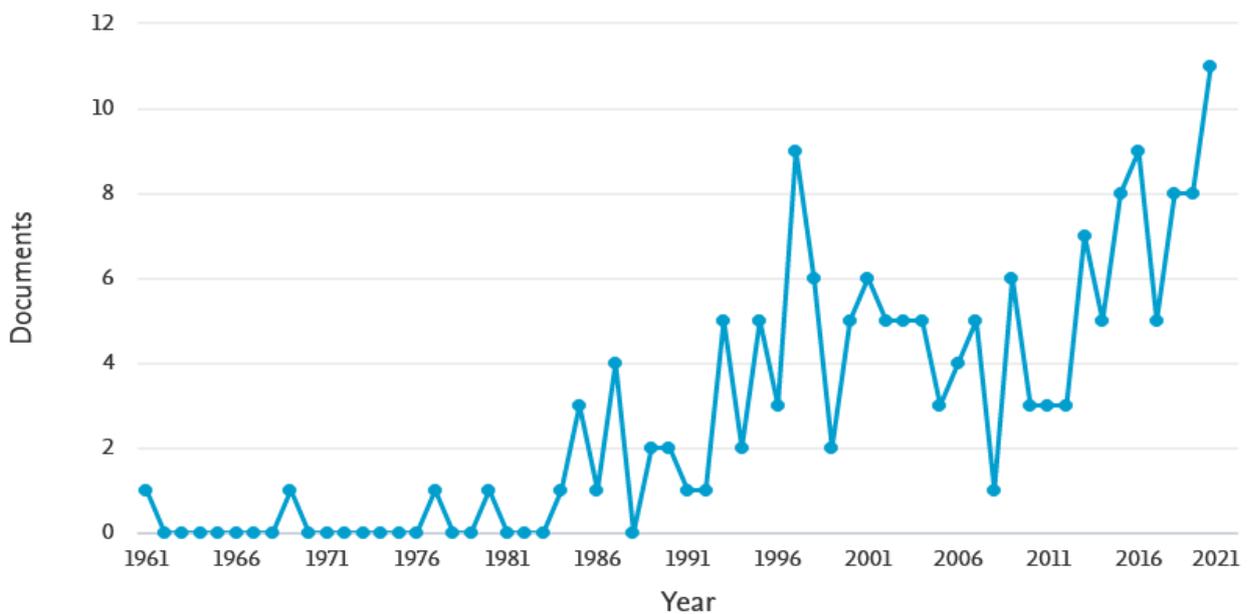Figure 1: Classification of the documents on "Aphanomyces root rot", Source: www.scopus.com

Figure 2: Period wise publication of articles, Source: WWW.scopus.com

Co-authorship analysis of top authors had been shown in figure 3. For a better presentation of the analysis, the parameters used were the minimum number of documents of an author as

four and the minimum number of citations of authors as one. This combination plotted the map of 30 authors, in 10 clusters. The overlay visualization map of co-authorship analysis plotted in Figure 3, points out the major researchers with their strong co-authorship linkages and clusters involved.
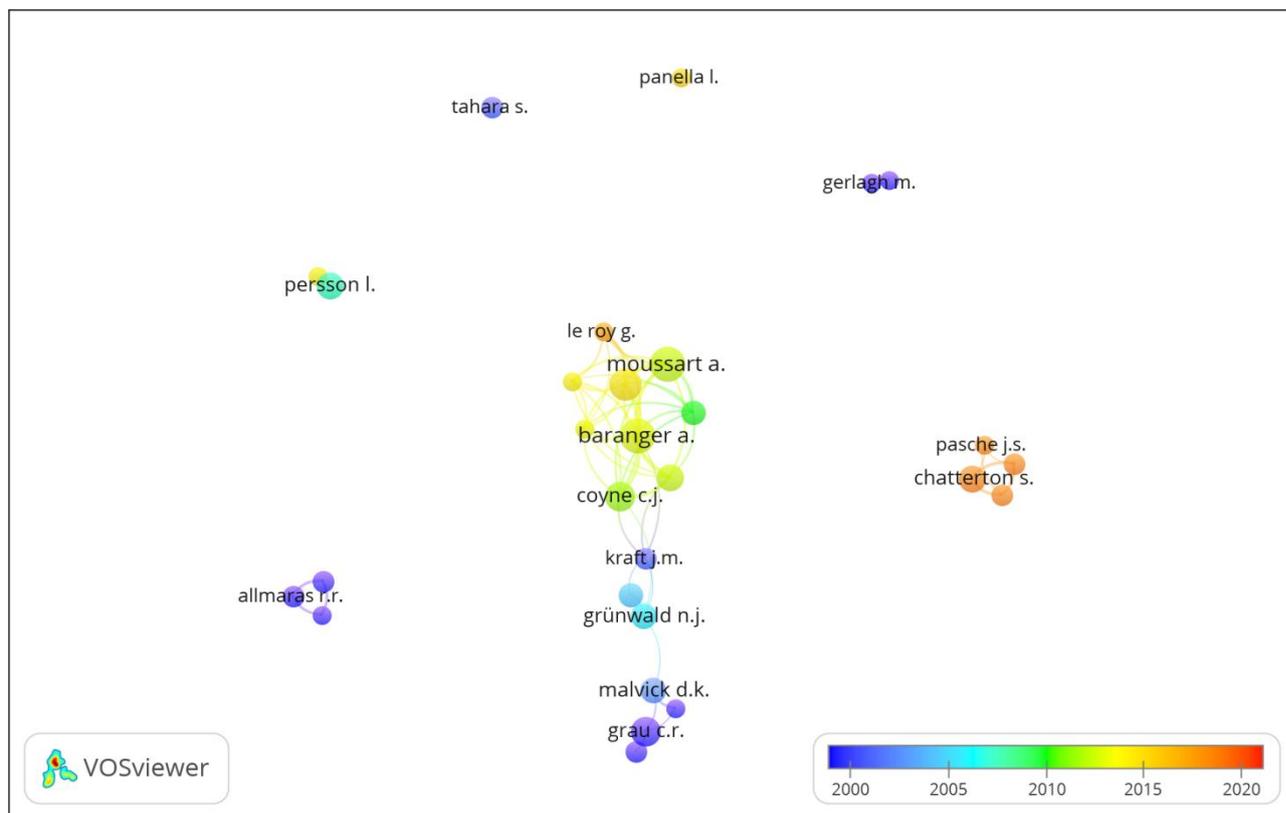

Figure 3: Co-authorship analysis on basis of authors

The citation analysis of top authors had been shown in table 1, along with co-authorship links. For the citation analysis, the parameters used were the minimum number of documents of an author as one and the minimum citations of an author as one.

Table 1: Highlights of most active authors

Description	Authors	Documents	Citations	Average citations per documents	Link strength
Authors with the highest publication, citations, and co-authorship links	Baranger A.	13	352	27.08	137
Authors with the highest average citation	Braun H.-P.	1	112	112	5
	Eubel H.	1	112	112	5
	Niehaus K.	1	112	112	5

In Co-occurrence analysis, we had used all keyword analyses, by keeping the minimum number of occurrences of a keyword as ten. This combination plotted the map of 32

thresholds, in three clusters. The overlay visualization of co-occurrence analysis of keywords has been shown in Figure 4.

Figure 4: Co-occurrence analysis on basis of all keywords

The most active and productive organizations engaged in research on "Aphanomyces root rot" had been found out by the co-authorship analysis and citation analysis, the parameters used are the minimum number of documents of an organization as one and the minimum number of citations of organizations as one. This combination plotted the map of 381 organizations, in 137 clusters.

The top research organization in the research regarding "Aphanomyces root rot" with the highest number of publications and citations in the United States Department of Agriculture of United States of America (Refer to table 2).

Table 2: Highlights of the most active organization

Organizations	Country	Documents	Citations	Average Citations per document
The United States Department of Agriculture	United States of America	35	659	16

Co-authorship analysis of the countries engaged in the research on "Aphanomyces root rot" had been shown in Figure 5. For a better presentation of the analysis, the parameters used were the minimum number of documents of an author as one and the minimum number of citations of authors as one. This combination plotted the map of 27 countries, 9 clusters. The

overlay visualization map of co-authorship analysis plotted in Figure 5, points out the main countries with their strong co-authorship linkages and clusters involved.
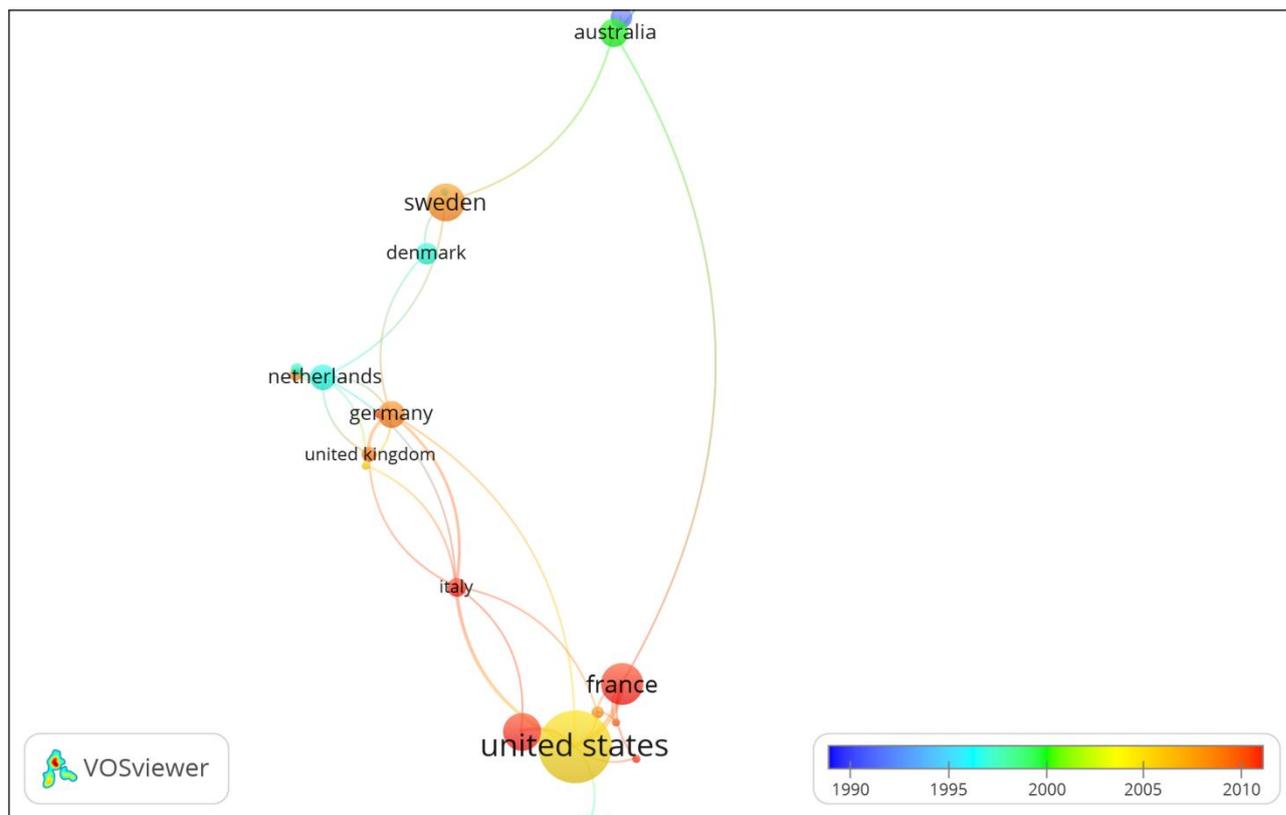

Figure 5: Co-authorship analysis on basis of countries

The citation analysis of top countries had been shown in table 3, along with co-authorship links. For the citation analysis, the parameters used were the minimum number of documents of a country as one and the minimum citations of the country as one.

Table 3: Highlights of Active Countries

Description	Country	Documents	Citations	Average citations per documents	Link strength
The country with the highest publication, citation, and co-authorship links	United States of America	68	1414	20.79	18
The country with the average citation	Poland	1	67	67	1

The most active country in this research domain was the United States of America with the highest number of publications, citations, and co-authorship links. Poland was the country with the highest average citation.

Link analysis and citation analysis were used to identify the most active journal in this research domain. We have taken the parameters of the minimum number of documents of a journal as one

and the minimum number of citations of a journal as one for the link analysis and citation analysis. Highlights of the most active and relevant journals related to the "Aphanomyces root rot" are shown in table 4. Table 4 shows the journal activity of this research domain through parameters of publication volume, citations, and co-authorship linkages. Plant Disease was the most active journal with the highest publications, citations, and co-authorship links and Plant Molecular Biology is the journal with the highest average citations.

Table 4: Analysis of journal activity

Description	Journal details	Documents	Citations	Average citations per documents	Link strength
Journal with the highest publications, citations, and co-authorship links	Plant Disease	22	470	21.36	150
Journal with the highest average citation	Plant Molecular Biology	1	112	112	7

From the above discussion regarding the bibliometric patterns in the research regarding the Aphanomyces root rot, this research had observed a gradual increase in research interest regarding the Aphanomyces root rot from the starting of the millennium and the momentum is going on positively. This points out the relevance and potential of this research domain (Refer to Figure 2). The most active author in this research domain is Baranger A. with the highest publication, citations, and co-authorship links. The highlights of authors with the highest average citation as shown in table 1 (Refer to table 1). The overlay analysis of top countries researching Aphanomyces root rot indicates that the United States of America was the leading country in research regarding Aphanomyces root rot disease with the highest publications, citations, and co-authorship links. Poland is having the highest number of average citations (Refer to figure 5). The top journals of this research domain were identified as Plant Disease and Plant Molecular Biology. From these wide sources of information, researchers can focus on top journals where they can identify the most relevant and highly cited articles regarding Aphanomyces root rot.

4. **Conclusion**

Aphanomyces root rot is an interesting research domain and the most active journals related to this plant disease are Plant Disease and Plant Molecular Biology. The most active countries was the United States of America and Poland. The leading organizations engaged in the research regarding Aphanomyces root rot was the United States Department of Agriculture of the USA. The most active authors who had made valuable contributions related to Aphanomyces root rot disease was Baranger A. This research domain offers a new avenue for researchers and the future research can be on disease control, developing chemical control measures, identifying new biological control measures, and development of resistant variants.

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