

Bibliometrics Using VOS viewer with Publish or Perish: Neural Network Research in Plant Disease Classification

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ABSTRACT

Plant diseases pose a severe threat to global food security and agricultural sustainability. The impact of plant diseases causes economic losses for farmers and food shortages for the population. To overcome this problem, research in agriculture utilizes advanced technologies such as neural networks to detect plant diseases. This study aims to understand the development of research on using neural networks in plant disease classification. This method used the Neural Network method to identify plant diseases from images, with a bibliometric analysis of 72 articles published between 2019 and 2024. The results of this study map the network of knowledge and collaboration in the use of neural networks for plant disease classification, identifying three main clusters that reflect the research focus and application of this technology. It was concluded that this study successfully understood the research developments related to using neural networks in plant disease classification

Keywords: Bibliometric, Plant Disease, Clusters, Neural Network

1. INTRODUCTION

Bibliometric analysis is a popular method for exploring and analyzing scientific data. Bibliometric analysis involves the quantitative evaluation and mapping scientific literature, including books, articles, and other written communications, to identify patterns, trends, and relationships within a particular field of study [1]. Bibliometric analysis plays an important role in tracking the evolution of research topics, assessing impact and productivity, identifying emerging areas of interest, and facilitating knowledge dissemination within disciplines [2] [3].

Tools such as VOS viewer are commonly used in bibliometric analysis to create, visualize, and explore bibliometric maps, thus allowing researchers to gain insights into research networks and collaborations [4]. By applying bibliometric methods, researchers can conduct topic evolution analysis, explore convergence in innovation, and produce visualization analysis of scientific publications to understand the research landscape in a particular domain [5].

Neural networks are inspired by the structure and function of the human brain, which is an essential computational model for tasks such as pattern recognition, classification, and prediction [6]. Neural networks consist of an input, hidden, and output layer with interconnected nodes that process data through weighted connections, mimicking the brain's neural connections. Various neural network architectures, such as multi-layer perceptron (MLP), extreme learning machine (ELM), and radial basis function (RBF), have been developed to optimize tasks such as online learning and conditional distribution prediction [7]. Applying neural networks in agriculture supports the broader goal of sustainable solutions for plant disease research [8]. Researchers can improve disease management strategies by utilizing neural networks, leading to increased crop yields and reduced economic losses.

Neural networks have been successfully applied to several studies on plant diseases. Research conducted by Taneja [9] applied CNN techniques for plant disease detection, which showed the effectiveness of neural networks in accurately identifying and classifying plant diseases based on visual symptoms. Using neural networks, researchers can improve the accuracy and efficiency of plant disease classification, which contributes to early detection and effective management strategies in agriculture. The difference between this research and previous research is that it provides a comprehensive, step-by-step guide with detailed visual aids, which prior research has not done.

Plant diseases in the agricultural sector encompass various conditions caused by pathogens, environmental factors, or nutrient deficiencies that can negatively impact plant health and productivity [8]. These diseases pose a significant threat to global food security and agricultural sustainability. Symptoms of plant diseases may include leaf spotting, wilting, discoloration, or abnormal growth patterns, ultimately leading to reduced yields and economic losses for farmers. Understanding the nature of plant diseases and implementing appropriate control measures is essential for farmers to reduce the spread of diseases and maintain the health of their crops.

This study aims to conduct a bibliometric analysis to understand the development of research on using neural networks in plant disease classification. This research uses the VOS viewer and Publish or Perish tools to map the knowledge network and collaboration between researchers and institutions in this field. The analysis aims to identify patterns, trends, and relationships in the scientific literature and uncover key clusters in this research topic. This research contributes to the field of neural networks by providing significant insights into research trends and the classification of plant diseases. The results of this analysis are expected to provide deeper insights into the evolution of the research topic and support the application of neural network technology in more effective plant disease classification.

2. RESEARCH METHOD

2.1. Prepare Research Tool

Before conducting bibliometric data analysis, several applications need to be prepared. First, we need a mapping tool, namely VOS viewer, an open-source application used to visualize and map the data that has been analyzed (Figure 1). In this research, VOS viewer will be a tool to create a visual map of the bibliometric data. Second, a reference manager application is needed to collect research data. Some applications that can be used are Publish or Perish (Figure 2) and Mendeley (Figure 3). These applications will assist in collecting and organizing research data that will be analyzed bibliometric using VOS viewer.

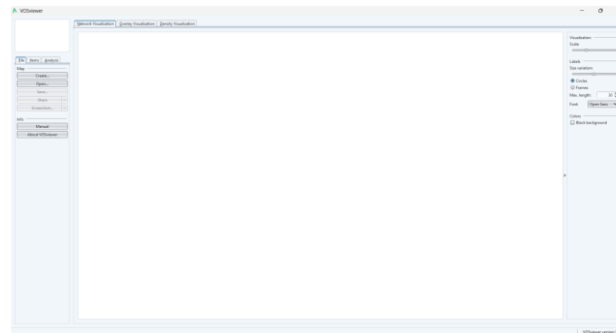


Figure 1. VOS viewer Application

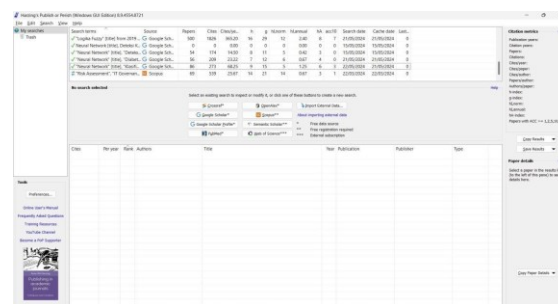


Figure 2. Publish or Perish Application



Figure 3. Mendeley Desktop Application

The analysis process carried out in this study is illustrated in Figure 4 below. This process is explained in detail in the next chapter

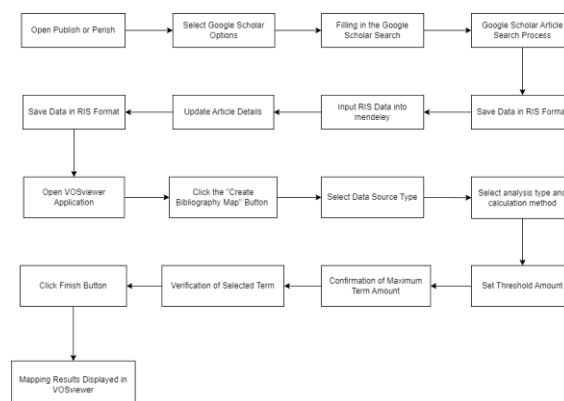


Figure 4. Flow of Research Process

2.2. Data Retrieval and Collecting

The data used in this research is from a journal publication regarding using neural networks in plant disease classification. This data is obtained through the reference manager application, Publish or Perish. Publish or Perish is used to conduct a literature review on the selected theme, resulting in a database with similar research themes. Publish or Perish helps find out the most frequently cited authors and the publication year of the oldest and latest articles and provides bibliometric records of each study to be used. This application offers several research data sources such as Google Scholar, Google Scholar Profile, PubMed, Microsoft Academic, Scopus, and Web of Science, as shown in Figure 5. In this study, data was taken from the Google Scholar database.

Data collection with data quality and accuracy is significant in research success. In this context, the researcher has collected a dataset of plant disease classification studied using neural networks. The data source is Google Scholar, a leading platform that provides various articles, journals, books, and other readings. The selection of this dataset was not done arbitrarily but through careful consideration to ensure that the data obtained meets the research objectives and is of reliable quality. Data retrieval is a mechanical download process that involves a deep understanding of the dataset's characteristics. The researcher needs to ensure that the data retrieved is highly relevant to the research focus and identify any potential biases or anomalies that may appear in the dataset. This step sets a strong foundation for the rest of the research journey, ensuring a solid foundation before entering further analysis.

2.3. Research Data Mapping

In this research, data visualization was carried out using the VOS viewer digital mapping application. The data that has been collected is processed to match the relevant keywords. After the processing, the data is inputted into the VOS viewer application, which then converts the data into a visual map showing the relationship between the data.

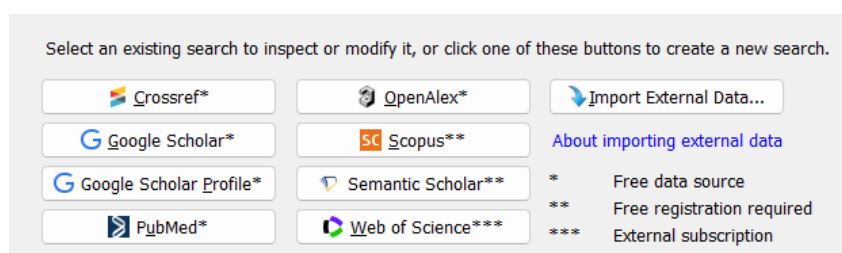


Figure 5. Data Source Options in Publish or Perish

3. RESULT AND ANALYSIS

This section discusses analyzing data visualization results using VOS viewer based on the development of the number of journal publications, focusing on using neural networks in plant disease classification from the Google Scholar database in the 2019-2024 range.

3.1. Data Collecting

For example, in this study, data was obtained through Google Scholar. This means that any articles relevant to the research theme will be searched. The article search results will be copied and entered into the Mendeley application to update the details across the selected articles. The steps to obtain the data are as follows.

A. Open the Publish or Perish Application

The first step is to open the Publish or Perish application, as shown in Figure 6. The initial display will appear after the application is open, as shown in Figure 7. Then, select the article provider source option from Google Scholar, as shown in Figure 8.

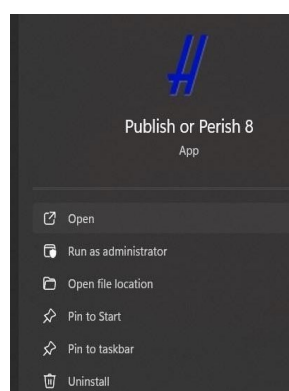


Figure 6. Open Publish or Perish Application

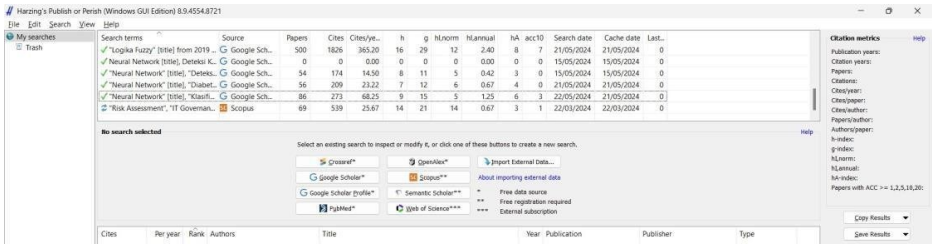


Figure 7. Publish or Perish App Home View

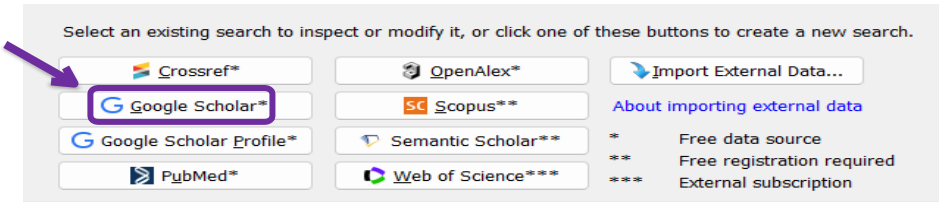


Figure 8. Select Google Scholar Options

B. Filling in the Google Scholar Search Section

In the Google Scholar search form shown in Figure 9, users can fill in several sections, such as authors, publication names, titlewords, and keywords. For this research, the theme searched is using neural networks in plant disease classification from articles published in 2019 - 2024 or the last five years. Furthermore, the maximum number of results can be set to 10, 20, 50, 100, 200, 500, or 1000 articles. The maximum number of results in this article search is set to 200 articles. After filling in the search form, click the “search” button in the upper right corner of Figure 8. Then, the Publish or Perish display will appear, as shown in Figure 10, and wait for the search process to finish.

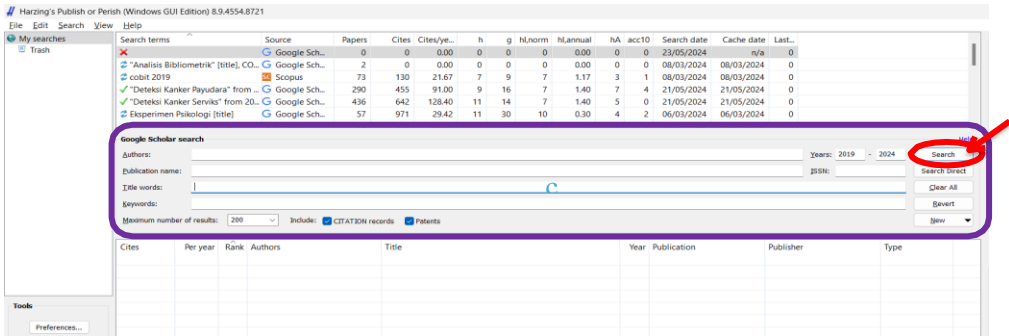


Figure 9. Google Scholar's Search Section

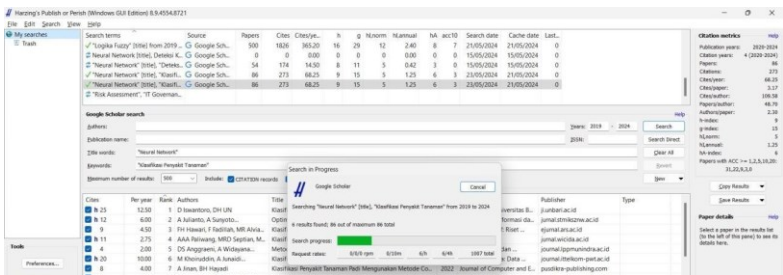


Figure 10. Google Scholar Article Search Process in Publish or Perish

C. Search Results

Figure 11 shows the search results displayed by Publish or Perish. Some information about the data can be found in the “Citation Metrics” section on the right side of the screen. In this study, 72 articles were found relevant to the theme searched. The publication year ranged from 2019 to 2024, with a citation year range of 4 years (2020 - 2024).

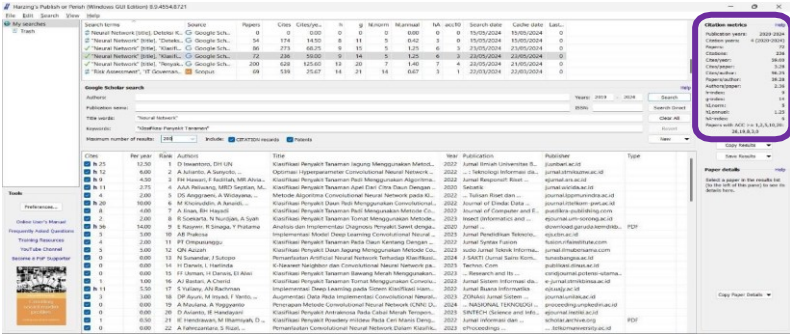


Figure 11. Google Scholar Article Search Results based on Publish or Perish

D. Copy-paste Search Result Data

The next step is to copy the search results by clicking the "Copy Result" button on the right side of Publish or Perish. Then, select copy in RIS format, as shown in Figure 12. Next, enter the Mendeley application, and it will display the initial display, as shown in Figure 13. Create a new folder in Mendeley (Figure 14), then paste the search result data so that it looks like Figure 15. This Mendeley application is used to update the details of all articles obtained.

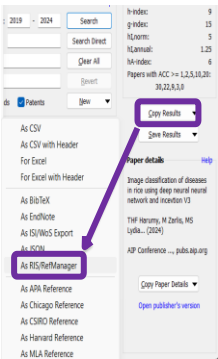


Figure 12. Copy Result Action as RIS

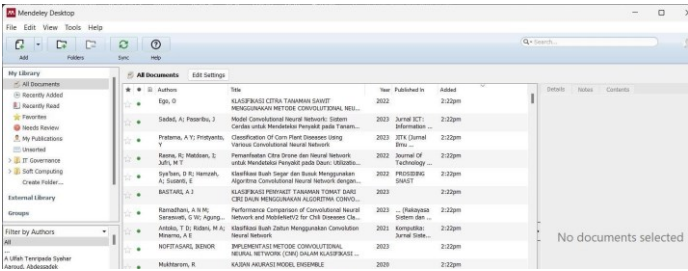


Figure 13. Mendeley App Home View

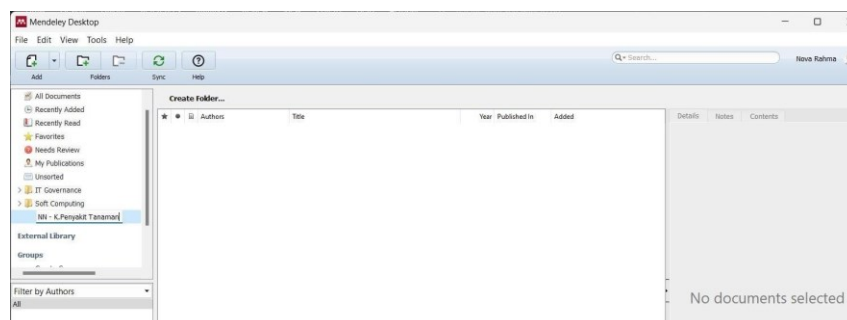


Figure 14. Create a New Folder for Article Search Result Data

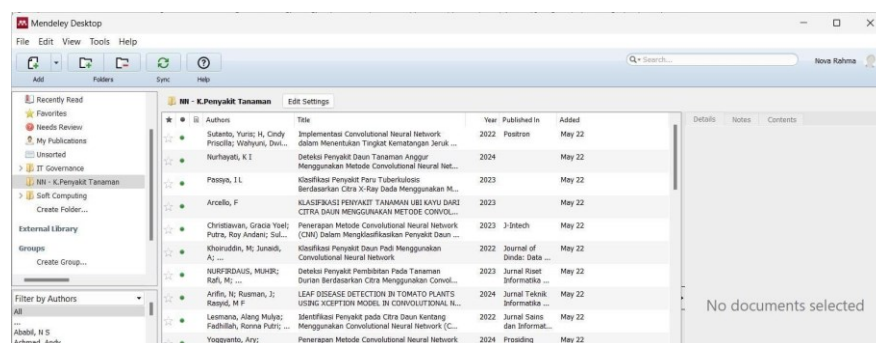


Figure 15. Insert the entire article search result data into the Mendeley Folder

E. Update Details Article

In the folder application created in Mendeley earlier, select all data by pressing the “Ctrl + A” key, then right-click and select the “Update Details” option (Figure 16). Then, wait for the update process to finish until the differences from the previous data are visible, as in Figure 17.

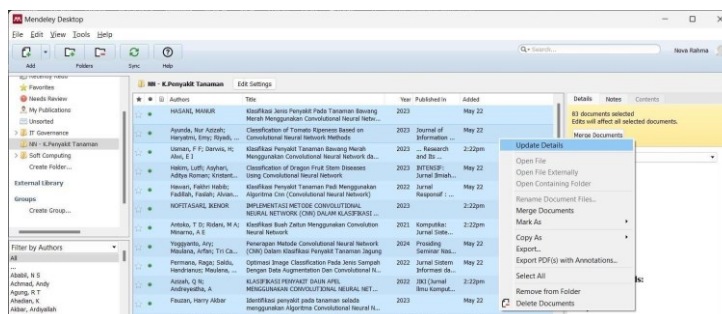


Figure 16. Update Details Data in Mendeley



Figure 17. Results of Update Details Data

The articles found in Publish or Perish are used as the basis for creating maps using VOS viewer. The data available in Publish or Perish is metadata, such as authors' names, titles, publication years, journal names, and article publishers. Table 1 shows the search results from Publish or Perish used in the VOS viewer analysis. There were 72 articles with 236 citations and 59.00 citations per year, with an average of 3.28 citations per article. The average number of authors per article was 2.36, with an h-index of 9 and a g-index of 14. In the table below, one article metadata for each year will be shown.

Table 1. Neural Network Research Data in Plant Disease Classification.

NO	Authors	Title	Year	AuthorCount	Cites	Cites/Year	Cites/ Author
1	IF Idenugraha, D Rahmawati	Automatic Pesticide Spray Based on DigitalImage Processing in Chili Plants by Classification Backpropagation Neural Network Method	2020	3	0.00	0.00	0.00
2	Y Rayhan, DB Setyohadi	Classification of GrapeLeaf Disease Using Convolutional Neural Network (CNN) with Pre-Trained Model VGG16	2021	2	3.00	1.00	2.00
3	A Julianto, ASunyoto	Hyperparameter Optimization of Convolutional NeuralNetwork for Rice PlantDisease Classification	2022	3	12.00	6.00	4.00
4	ANM Ramadhani, GW Saraswati, RT Agung	Performance Comparison of Convolutional Neural Network and MobileNetV2 for ChiliDiseases Classification	2023	4	1.00	1.00	0.00
5	N Arifin, J Rusman, MFRasyid	Leaf Disease Detectionin Tomato Plants Using Xception Modelin Convolutional Neural Network Method	2024	3	0.00	0.00	0.00

3.2. Publication Development

Based on the search results in the Google Scholar database, Table 2 shows the research development on using neural networks in plant disease classification. From the table data, 72 studies related to this topic were recorded. The number of studies shows a fluctuating trend but tends to increase, as illustrated in Figure 18. In 2020, 6 articles discussed the classification of plant diseases using neural networks. The following year, the number of articles decreased to 2 in 2021. However, research interest increased sharply in 2022 with 20 articles and increased in 2023 with 36 articles. In 2024, the number of studies decreased slightly to 8 articles. The significant increase in research interest in 2022 and 2023 indicates that using neural networks in plant disease classificationis becoming an increasingly important topic among researchers. This may be due to technological advances and the urgent need to improve efficiency and accuracy in detecting plant diseases to minimize economic losses in the agricultural sector.

Table 2. Development of Research Publications

Year of Publication	Number of Publication
2020	6
2021	2
2022	20
2023	36
2024	8
TOTAL	72

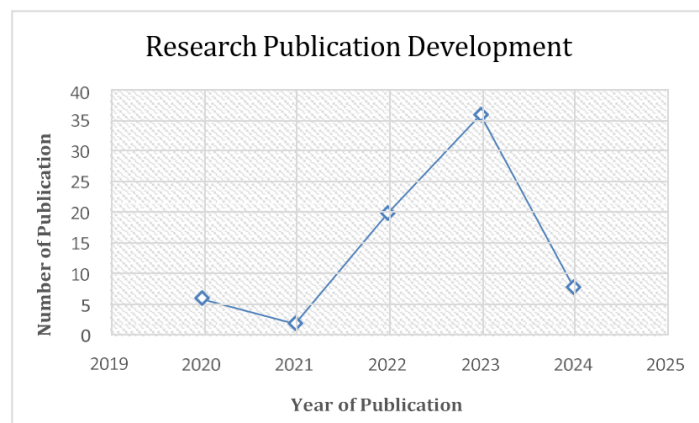


Figure 18. Development Chart of Number of Publications

3.3. Bibliometric Mapping Modeling

From the search results through the Google Scholar database, 72 research documents related to plant disease classification using neural networks were obtained. These documents are then exported into RIS format to be inputted and analyzed using VOS viewer. There are several steps to conduct research mapping using VOS viewer, including:

A. Opening the VOS viewer Application

The first step is to open the VOS viewer application already installed on the device. After opening, the initial VOS viewer window will appear, as shown in Figure 19.



Figure 19. Initial View of VOS viewer Application

B. Click the “Create” button to Start Creating a New Map

After opening VOS viewer, click “Create”, as shown in Figure 18, to create a new map. As shown in Figure 20, there are three data type options: create a map based on network data, bibliographic data, and text data. In this research, the map is made based on bibliographic data (create a map on bibliographic data) because it uses metadata from the articles that have been collected. Then click next.

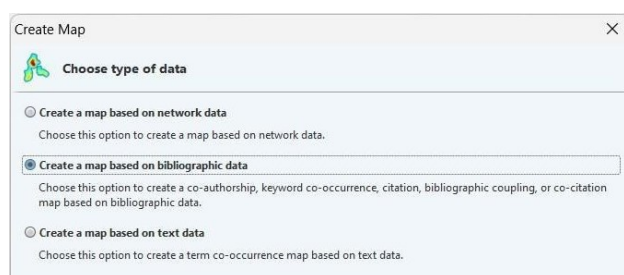
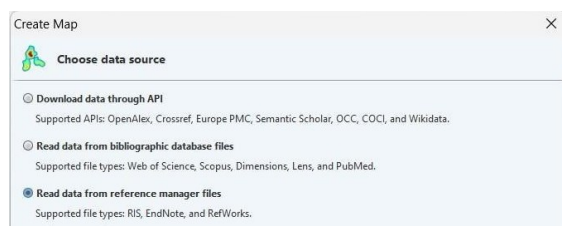
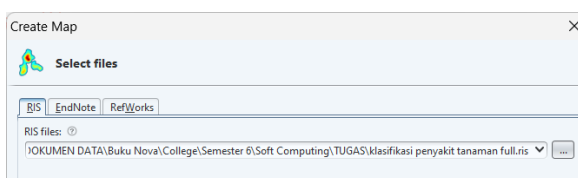


Figure 20. Creating a New Map based on Bibliometrics

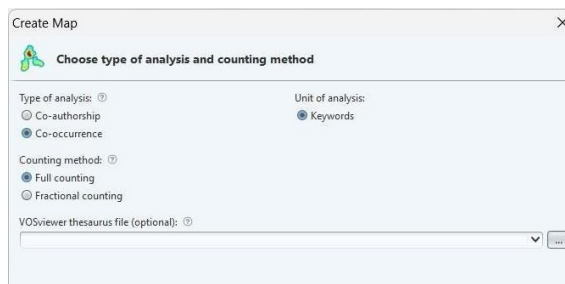
C. Selecting and Defining Data

Figure 21 shows the next step in creating a research folder. There are three data source options: download data through API, read data from bibliographic database files, and read data from reference manager files. Since the previously collected data is stored in RIS format using the Publish or Perish and Mendeley applications, select the "Read data from reference manager files" option and click next. Select the RIS section on the page shown in Figure 22 and press the three-dot button to enter the file previously saved in RIS format. Once the file is selected, click the following button to proceed to the next step.

**Figure 21.** Data Source Options by Type**Figure 22.** Selection of RIS File to be Used as Data Source for Mapping

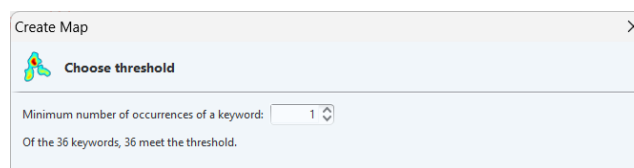
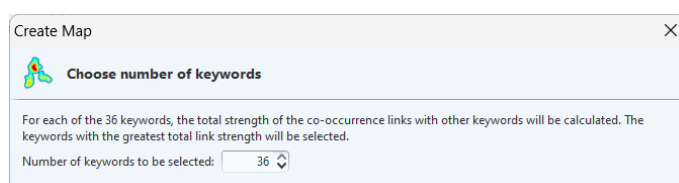
D. Select Analysis Type and Counting Method

The next step is to select the type of analysis used and the counting method, as shown in Figure 23. This page displays two kinds of analysis: co-authorship based on author and co-occurrence based on keywords. In this research, select “Co-occurrence” to analyze the frequency of keyword occurrences. Then, there is a choice of counting method: select the “Full Counting” method and then click next to continue.

**Figure 23.** Selection of Analysis Type and Counting Method

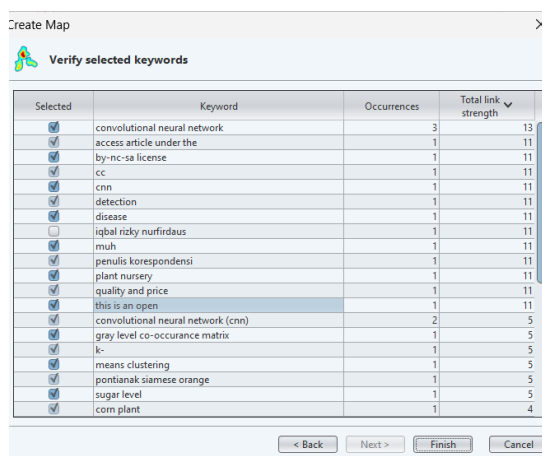
E. Select Threshold

At this stage, select the minimum Threshold for keywords that appear in the analysis. Figure 24 shows the "Choose Threshold" page in VOS viewer. This page sets the minimum frequency of keywords that appear to be included in the mapping. Threshold displays words that occur at least once, so this study used a threshold of one word. However, in other studies, the Threshold may display more than one minimum word that appears. With this setting, the number of keywords found is 36 and will be included in the mapping. Figure 25 shows the final result of the data display, maximizing the data visualization by 36 keywords.

**Figure 24.** Threshold Section Options in VOS viewer**Figure 25.** Maximum Term Count

F. Verification of Selected Terms

In this final stage, the words selected for research mapping were verified. Figure 26 shows the list of keywords that appear and will be used in the mapping. If there are keywords that are deemed less relevant, the keywords can be unchecked. Due to topic differences, some keywords were not used to ensure comprehensive analysis in this research. After verification is complete, click the “Finish” button. The final results of the research theme mapping on plant disease classification using neural networks can be seen in Figure 27.



Selected	Keyword	Occurrences	Total link strength
☒	convolutional neural network	3	13
☒	access article under the	1	11
☒	by-nc-sa license	1	11
☒	cc	1	11
☒	cnn	1	11
☒	detection	1	11
☒	disease	1	11
☐	iqbal risky nurfirdaus	1	11
☒	muh	1	11
☒	penulis korespondensi	1	11
☒	plant nursery	1	11
☒	quality and price	1	11
☒	this is an open	1	11
☒	convolutional neural network (cnn)	2	5
☒	gray level co-occurrence matrix	1	5
☒	k-	1	5
☒	means clustering	1	5
☒	pontianak siamase orange	1	5
☒	sugar level	1	5
☒	corn plant	1	4

Figure 26. Verify Word Choice in VOS viewer

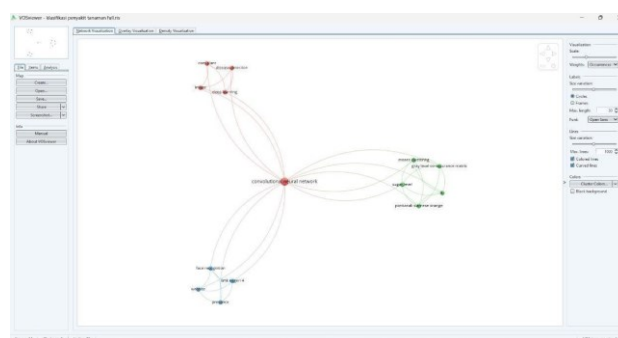


Figure 27. Research Mapping Results using VOS viewer

The results of the network visualization of the keywords map regarding the classification of plant diseases are divided into three main clusters, as shown in Figure 28 below.

Cluster 1. Titled Classification of Corn Plant Diseases Using Various Convolutional Neural Networks. The red color consists of 5 items: convolution neural network, corn plant, deep learning, disease detection, and image. These keywords have been used and discussed in research; Classification of Corn Plant Diseases Using Various Convolutional Neural Networks [10]; TA: Identification of Apple Leaf Diseases Using Resnet 50 Dilated Convolution Neural Network [11]; Classification of Grape Leaf Disease Using Convolutional Neural Network (CNN) with Pre-Trained Model VGG16 [12]; Classification of Tomato Ripeness Based on Convolutional Neural Network Methods [13]; Classification of Dragon Fruit Stem Diseases Using Convolutional Neural Network [14]; Performance Comparison of Convolutional Neural Network and MobileNetV2 for Chile Diseases Classification [15]; Detection of Alzheimer's Disease in Magnetic Resonance Imaging Images Using Machine Learning with Convolutional Neural Network Method [16]; Classification of Corn Plant Diseases Using Various Convolutional Neural Networks [17]; Classification of Potato Leaf Diseases Using Convolutional Neural Network [18]; Disease Detection of Rice and Chili Based on Image Classification Using Android-Based Convolutional Neural Network [19]; Transfer Learning Convolutional Neural Network with Efficient net Architecture for Chili Leaf Disease Identification [20]; Leaf Disease Detection in Tomato Plants Using Exception Model in Convolutional Neural Network Method [21]; Development of Apple Fruit Classification System using Convolutional Neural Network (CNN) Mobile Net Architecture on Android Platform [22]; Corn Disease Classification Using Convolutional Neural Network with Weighted Loss [23]; Classification of Fresh or Rotten Fruits and Vegetables Using Convolutional Neural Network [24]; Identification of Fish Freshness Using Convolutional Neural Network [25]; Classification of Tea Leaf Diseases Using Convolutional Neural Network [26]; Classification of Distracted Driver Using Support Vector Machine Based on Principal Component Analysis Feature Reduction and Convolutional Neural Network [27]; Classification of Corn Leaf Diseases using Loss-Fused Convolutional Neural Network [28]; Analysis and Implementation of Palm Disease Diagnosis with Convolutional Neural

Network (CNN) Method [29]; The Effect of Hyperparameter Tuning on Coffee Bean Roasting Level Classification Using Convolutional Neural Network Algorithm [30]; Utilization of Convolutional Neural Network in Cassava Plant Disease Classification Using Dense net Architecture [31]; Cassava Plant Disease Classification from Leaf Images Using the Convolutional Neural Network Method [32]; Study of the Accuracy of Ensemble Convolutional Neural Network Model for Classification of Tomato Plant Diseases Based on Leaf Image Data [33].

Cluster 2. Titled Implementation of Convolutional Neural Network in Determining the Ripeness Level of Pontianak Siamese Oranges Based on Images. The green color consists of 4 items: gray level co-occurrence matrix, k-means clustering, Pontianak Siamese, and sugar level. These keywords have been used and discussed in the research: Implementation of Convolutional Neural Network in Determining the Ripeness Level of Pontianak Siamese Oranges Based on Images [34]; Optimization of Convolutional Neural Network Hyperparameters for Classification of Rice Plant Diseases [35]; Convolutional Neural Network Algorithm Method in Classification of Chili Plant Diseases [36]; Detection of Alzheimer's Disease in Magnetic Resonance Imaging Images Using Machine Learning with the Convolutional Neural Network Method [16]; K-Nearest Neighbor and Convolutional Neural Network on Red Onion Plant Disease Classification [37]; Butterfly Image Classification using Convolution Neural Network with Alex Net Architecture [37]; Classification of Corn Leaf Disease Using Alex Net Convolutional Neural Network Method [39].

Cluster 3. Titled Classification of Plant Diseases on Corn Leaves with Website-Based Convolutional Neural Network. The blue color consists of 4 items: face recognition, presence, SMK Negeri 4, and website. These keywords have been used and discussed in the following studies: Classification of Plant Diseases on Corn Leaves with Website-Based Convolutional Neural Network [40]; Classification of Powdery Mildew Disease on Sweet Cherries Using Convolutional Neural Network Algorithm [41]; Implementation of Deep Learning on Rice Plant Pest Classification System Using Convolutional Neural Network Method [42]; Classification of Plant Diseases on Potato Leaves with Convolutional Neural Network Method Mobile Net Architecture [43]; Identification of Lettuce Plant Diseases Using Convolutional Neural Network Algorithm [44]; Convolutional Neural Network Model: Intelligent System for Detecting Diseases on Vegetable Plants [45]; Detection of Seedling Diseases on Durian Plants Based on Image Using Convolutional Neural Network [46]; Pest Detection on Apple Leaves Using Convolutional Neural Network Algorithm [47]; Deep Neural Network to Classify Seabed Sediment Using MBES Multifrequency [48]; Classification of Sad Emotions and Depression Through Images Using Convolutional Neural Network (CNN) [49].

The red cluster includes terms closely related to techniques and methods in plant disease classification using neural networks. The green cluster includes terms related to analysis methods and specific objects in plant disease research. Blue clusters include terms related to technology applications in the context of education and online platforms. This visualization helps understand the main focus and distribution of keywords in the analyzed research.

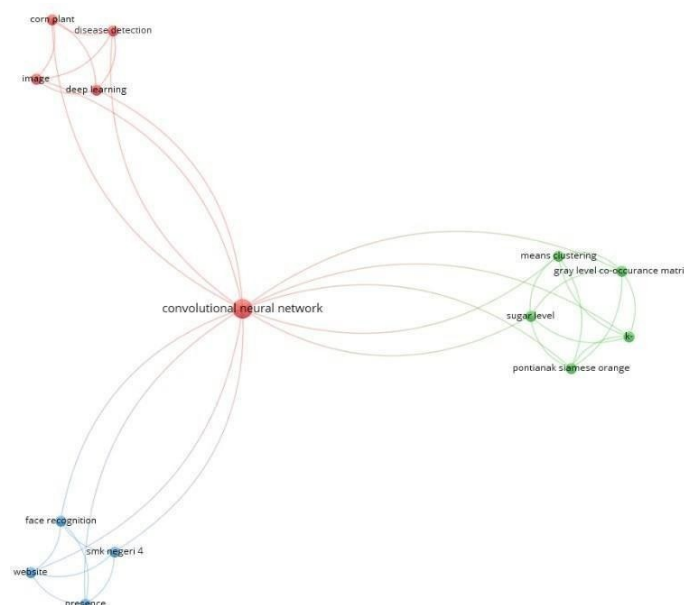


Figure 28. Co-word map network visualization

The cluster density visualization shows the items marked based on their number of occurrences. The item dots are colored depending on the density of items at that location. The color of the dot changes according to the number of items associated with it. Map Density is a tool designed to display the density of genomic features along chromosomes, offering customizable color scales for optimal data representation [49]. Co-Word Map Density is very useful for getting an overview of the structure of a bibliometric map by showing which are the most significant items to analyze [51]. Based on the research results shown in Figure 29, it can be interpreted that the most frequently

used keywords in publications show the visualization of the keyword density map for plant disease classification research.

Figure 29 displays a density map analyzing all articles on plant disease classification from 2019 to 2024. This density map shows that the more yellow and the larger the circle's diameter, the more frequently the keywords appear. Conversely, the keywords rarely appear if the color fades, merges with the background, and becomes green [52].

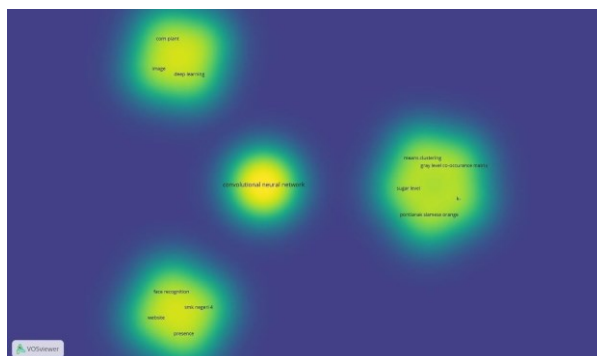


Figure 29. Co-Word Map Density Visualization

4. CONCLUSION

Based on the results and discussion above, VOS Viewer can be used as a mapping tool for bibliometric data analysis. In this study, the data used for analysis with VOS Viewer is research on using Neural Networks in plant disease classification taken from the Google Scholar database. The number of publications related to this theme reached 72 articles within the last five years, from 2019 to 2024. Changes in the number of publications during this period fluctuated but tended to increase rapidly from 2022 to 2023. Through network visualization, it can be seen that the map of research developments on Neural Networks is divided into 3 clusters. Cluster One consists of 5 topics, Cluster Two consists of 4 topics, and Cluster Three consists of 4 topics.

This confirms that Cluster One, with five topics, is the largest and most significant cluster in research activity among these clusters. This cluster is titled "Corn Plant Diseases Using Various Convolutional Neural Networks" and covers topics such as convolution neural network, corn plant, deep learning, disease detection, and image. This cluster's strengths include terms closely related to techniques and methods in plant disease classification using neural networks. Given the rapid progress and importance of this topic in Plant Disease Classification, it is clear that this cluster has significant potential for future research. Continued exploration and innovation in this cluster will likely yield valuable insights and advances, making it a promising area for ongoing and future research.

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