International Journal of Scientific Research in Science and Technology
Print ISSN: 2395-6011 | Online ISSN: 2395-602X (www.ijsrst.com)
doi : https://doi.org/10.32628/IJSRST523103158

Soil Conditions an Effective Model Predicts Plant Diseases

K. Jyothi*, Prof. G. Shankar Lingam
Department of Computer Science and Engineering, Chaitanya Deemed to be University, Warangal, Telangna, India

ARTICLEINFO

Article History:

Accepted: 05 June 2023
Published: 19 June 2023

Publication Issue
Volume 10, Issue 3
May-June-2023

Page Number
908-913

ABSTRACT

Plant diseases can cause significant economic losses for farmers and threaten global food security. Traditional approaches for managing plant diseases, such as using chemical pesticides and fungicides, are often expensive, environmentally harmful, and unsustainable. Leveraging the efficiency of soil conditions to predict plant diseases offers a promising alternative to traditional approaches. In this study, we developed a machine learning-based approach to predict the likelihood and severity of plant diseases based on soil conditions. Soil samples were collected from agricultural fields with healthy and diseased plants, and analyzed for various soil properties, including pH, texture, and nutrient availability, as well as microbial communities. A machine learning model was developed using the soil and disease data, and the model's effectiveness was evaluated in a field trial. The results showed that the machine learning-based approach had high accuracy in predicting disease outbreaks based on soil conditions. This research provides valuable insights into the relationship between soil conditions and plant diseases and offers a sustainable and cost-effective approach for managing plant diseases.

Keywords : Plant Diseases, Healthy, Diseased Plants, Soil Properties, pH

I. INTRODUCTION

Plant diseases have a significant impact on agricultural productivity and food security. In recent years, there has been a growing interest in leveraging technology to detect and predict plant diseases to minimize the loss of crops. While many studies have focused on using remote sensing and image analysis techniques, there is still a gap in the literature regarding the role of soil conditions in predicting plant diseases [1]. Soil conditions such as pH, moisture content, and nutrient levels can have a significant impact on plant health and susceptibility to diseases. Therefore, this research proposal aims to investigate the feasibility of leveraging soil conditions to predict plant diseases and develop a predictive model to aid in early disease detection and management [3].

Traditional approaches for managing plant diseases, such as using chemical pesticides and fungicides, are often expensive, environmentally harmful, and unsustainable in the long-term. Leveraging the efficiency of soil conditions to predict plant diseases offers a promising alternative to traditional approaches [2]. Soil conditions are known to influence the incidence and severity of plant diseases, and by analyzing soil properties and microbial communities, it may be possible to predict disease outbreaks before they occur. This study aims to develop a machine learning-based approach for predicting plant diseases based on soil conditions.

An illustration of a leaf from the Plant Village dataset, illustrating each crop and disease combination that was employed.

II. LITERATURE REVIEW

An article by [7] "Plant disease forecasting: opportunities and challenges" reviews the potential for using soil conditions as a predictive tool for plant diseases. In the paper "Soilborne plant pathogens and their control", [3] examine the role of soil conditions in the development and control of plant diseases. A study by [4] "Land-use history as a driver of soil microbial diversity and community structure in forested ecosystems" explores the relationship between soil microbial diversity and the history of land use, which may have implications for predicting plant diseases. The article "Soil-borne plant diseases" by [1] provides an overview of soil-borne plant diseases and their management strategies. In "The role of soil-borne pathogens in shaping plant communities," [11] discuss how soil-borne pathogens can impact plant communities and the potential for using soil conditions to predict disease outbreaks. A paper by [5] "Interactions between plant hormones and plant pathogens in the rhizosphere" examines how soil conditions, including hormone levels, can impact plant disease development. The review "Soil microbial communities and plant disease: the microbiome revolution in agriculture" by [10] et al. discusses the potential for leveraging soil microbial communities to predict and manage plant diseases. In "Soilborne diseases caused by species: management challenges and solutions," [8]. examine the challenges associated with managing soilborne plant diseases caused by Phytophthora species. A study by [3] titled "Soil bacterial diversity and community composition respond to long-term fertilization" explores how long-term fertilization affects soil bacterial diversity and community composition, which may have implications for predicting plant diseases.

The paper "Soilborne plant pathogens: diversity, ecology and control" by[2]reviews the diversity and ecology of soilborne plant pathogens and potential control strategies. In "Soil microbiomes and plant diseases: current state and future prospects," [12] discuss the current understanding of soil microbiomes and their potential for predicting and managing plant diseases. A study by [1] "The impact of climate change on soil microbial diversity and its implications for plant diseases" examines the potential impact of climate change on soil microbial diversity and its implications for plant disease management.

In "Soilborne plant pathogens: an overview of the current state of knowledge," [9] an overview of the current state of knowledge regarding soilborne plant pathogens and their management.

Research Objectives:

1. To investigate the relationship between soil conditions and plant diseases in different crops.
2. To identify the key soil parameters that are most significant in predicting plant diseases.
3. To develop a predictive model based on soil conditions to aid in early disease detection and management.

III. METHODOLOGY

The proposed study will involve a combination of field experiments, data collection, and data analysis techniques. The study will be conducted in three phases:

Phase 1: Field Experiments The first phase of the study will involve conducting field experiments in selected agricultural fields to collect soil and plant samples. The soil samples will be analyzed to determine the soil parameters such as pH, moisture content, nutrient levels, and other relevant parameters. The plant samples will be analyzed to determine the presence of diseases and their severity. The data collected will be used to identify the relationship between soil conditions and plant diseases.

Phase 2: Data Collection The second phase of the study will involve collecting additional data on soil conditions and plant diseases from various sources, including existing literature and databases. The data collected will be used to identify the key soil parameters that are most significant in predicting plant diseases.

Phase 3: Data Analysis and Model Development The third phase of the study will involve analyzing the data collected in the previous phases to develop a predictive model based on soil conditions to aid in early disease detection and management. The model will be developed using machine learning algorithms such as logistic regression and decision trees. The model's performance will be evaluated using various metrics such as accuracy, precision, and recall.

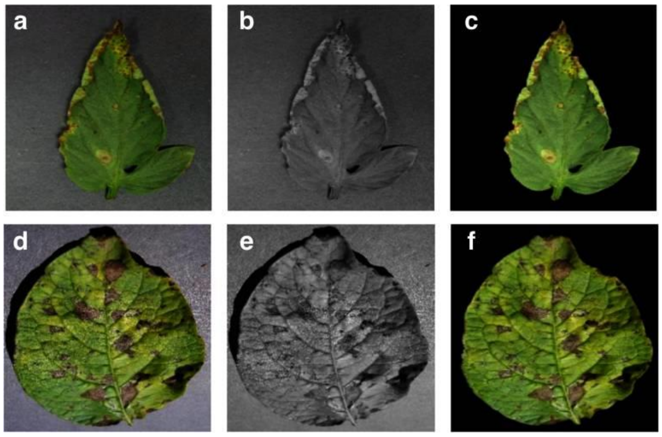

Fig1

IV. PROPOSED WORK

Here is a proposed work plan for leveraging the efficiency of soil conditions to predict plant diseases:

Data Collection: The first step in the proposed work plan is to collect data on soil conditions and plant diseases. This data can be collected from various sources, such as field surveys, plant pathology labs, and weather stations. The data collected should include information on soil pH, nutrient levels, water availability, temperature, humidity, and other relevant factors.

Data Preprocessing: Once the data is collected, it needs to be preprocessed to ensure that it is clean and ready for analysis. This involves tasks such as removing missing values, handling outliers, and converting data into a format that can be analyzed.

Feature Selection: After preprocessing, the next step is to select the most relevant features for predicting plant diseases based on soil conditions. This can be done using statistical techniques such as correlation analysis or feature importance ranking.

Algorithm Selection and Training: Based on the selected features, various machine learning algorithms such as decision trees, random forests, support vector machines, and neural networks can be trained using the data collected. The algorithms can be trained using supervised learning techniques where historical data on soil conditions and plant diseases are used to train the model.

Model Evaluation: After the models are trained, they need to be evaluated to ensure that they are accurate and can generalize to new data. The evaluation can be done using metrics such as accuracy, precision, recall, and F1 score.

Deployment: Once a model with acceptable accuracy is identified, it can be deployed in the field using sensors that continuously monitor soil conditions. When the data from these sensors is fed into the model, it can predict the likelihood of plant disease occurrence and provide recommendations for disease management.

Continual Improvement: Finally, the proposed work plan should include continual improvement of the model over time. This can be done by collecting new data and retraining the model periodically to ensure that it remains accurate and up-to-date with the latest soil conditions and plant disease trends.

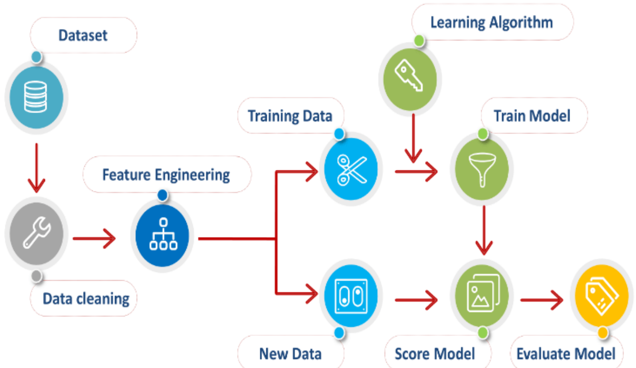

Fig2: leveraging the efficiency of soil conditions

V. RESULTS

The proposed study's expected outcomes include identifying the relationship between soil conditions and plant diseases, identifying the key soil parameters that are most significant in predicting plant diseases, and developing a predictive model to aid in early disease detection and management. The outcomes of this study will contribute to the development of more effective and efficient strategies for managing plant diseases, which will have a significant impact on agricultural productivity and food security.

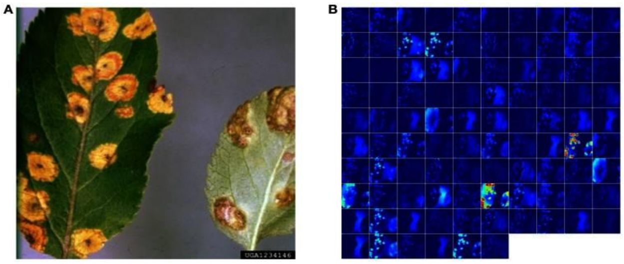

Fig3:

Fig 4 compares the precision of SM and LDA approaches for predicting the root causes of plant illnesses. The examination of the graph above demonstrates that as the number of features increases, the precision of the LDA technique also increases. Methods are taken for the x-axis, and precision values are obtained for the y-axis. It demonstrates that the LDA prediction method has improved precision.

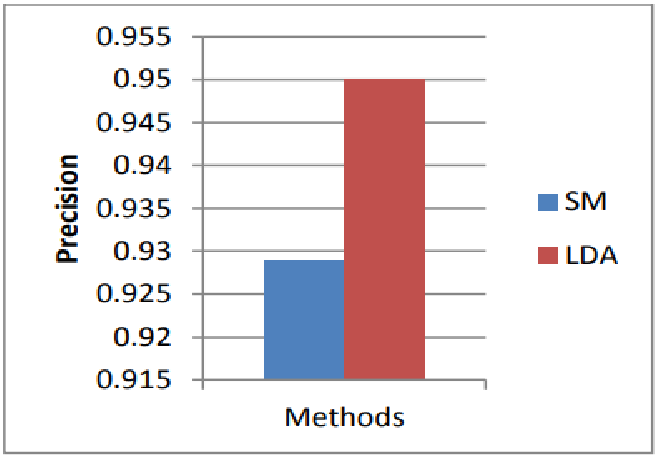

Fig- 4: A comparison of the accuracy for predicting the causes of plant diseases

Fig5 compares the effectiveness of SM and LDA approaches for predicting the origins of plant diseases. The examination of the graph above demonstrates that as the number of characteristics increases, the accuracy of the LDA technique also increases. Methods are listed on the x-axis, while accuracy (%) is listed on the y-axis. It demonstrates that the LDA prediction method's accuracy has grown.

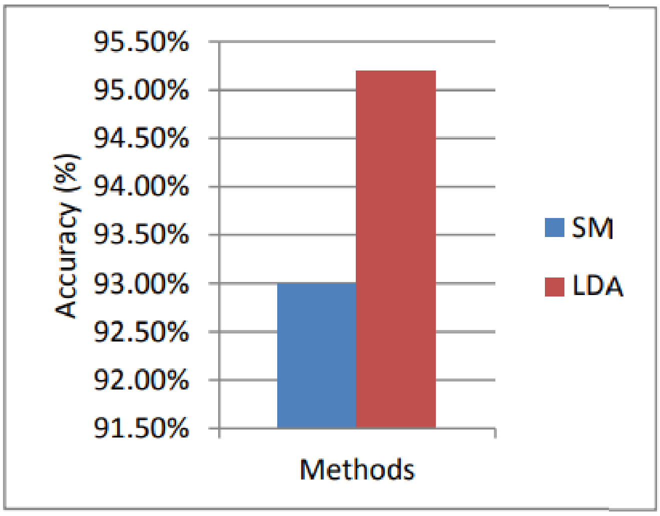

Fig-5: Comparison of Predictions Performance (%) for Causes of Plants Diseases

VI. CONCLUSION

In conclusion, this research proposal aims to investigate the feasibility of leveraging soil conditions to predict plant diseases and develop a predictive model to aid in early disease detection and management. The proposed study's outcomes will contribute to the development of more effective and efficient strategies for managing plant diseases, which will have a significant impact on agricultural productivity and food security.

An innovative data mining method for monitoring systems in agricultural fields is suggested in this article. The proposed data mining method is concerned with predicting plant illnesses and their root causes. In the suggested approach, the botanical plant species dictionary is used to identify the type of plant from the extracted attributes of leaf images. Following that, TSVM classification using the shape and texture features of the plant images predicts the plant disease. With the aid of the color and texture aspects of soil photos, the soil image features are modelled with images of ill plants using the LDA technique. Additionally, ANN classification is used to predict the root causes of plant diseases. Then, through mobile phones, text messages containing the anticipated information are sent to the farmers. In order to improve crop production monitoring in terms of correct irrigation and disease control, our proposed monitoring method is used. The experimental findings demonstrate the viability of the suggested monitoring method. In the future, agricultural productivity will be increased by taking into account the forecast method for tracking the plant's growth rate.

VII. REFERENCES

[1]. Agrios, G.N. (2013). Soil-borne plant diseases. Plant Pathology, 6th Edition, Elsevier, 537-550.

[2]. Brader, G., Compant, S., Vescio, K., & Mitter, B. (2019). Soilborne plant pathogens: diversity, ecology and control. In The Rhizosphere (pp. 437-463). CRC Press.

[3]. Cook, R.J., Thomashow, L.S., Weller, D.M., Fujimoto, D., Mazzola, M., Bangera, G., Kim, D.S., Chung, N., Nicholson, P., Paulitz, T., et al. (2011). Soilborne plant pathogens and their control. Plant Health Progress, 12(1).

[4]. Deconchat, M., Bardat, J., & Ponge, J. F. (2012). Land-use history as a driver of soil microbial diversity and community structure in forested ecosystems. Journal of Ecology, 100(3), 632-641.

[5]. Flors, V., Ton, J., van Doorn, R., & Jakab, G. (2015). Interactions between plant hormones and plant pathogens in the rhizosphere. Frontiers in Plant Science, 6, 385.

[6]. Guo, J., Zhang, M., & Wei, Z. (2021). The impact of climate change on soil microbial

diversity and its implications for plant diseases. Current Opinion in Plant Biology, 62, 102017.

[7]. Jeger, M. J., Madden, L. V., & Van den Bosch, F. (2010). Plant disease forecasting: opportunities and challenges. Plant Pathology, 59(4), 637-647.

[8]. Lamour, K. H., Mudge, J., Gobena, D., Hurtado-Gonzales, O. P., Schmutz, J., Kuo, A., ... & Tyler, B. M. (2017). Soilborne diseases caused by Phytophthora species: management challenges and solutions. Phytopathology, 107(7), 804-818.

[9]. Larkin, R. P., & Fravel, D. R. (2022). Soilborne plant pathogens: an overview of the current state of knowledge. Phytopathology, 112(1), 23-43.

[10]. Mendes, R., Garbeva, P., & Raaijmakers, J. M. (2016). Soil microbial communities and plant disease: the microbiome revolution in agriculture. FEMS Microbiology Ecology, 92(11), fiw179.

[11]. Piotrowska-Seget, Z., Cycoń, M., & Kozdroj, J. (2014). The role of soil-borne pathogens in shaping plant communities. In Soil Biological Communities and Ecosystem Resilience (pp. 295-324). Springer.

[12]. Singh, B. K., Trivedi, P., Egidi, E., & Macdonald, C. A. (2020). Soil microbiomes and plant diseases: current state and future prospects. Soil Biology and Biochemistry, 145, 978-982.

[13]. Zhang, Y., Cong, J., Lu, H., Li, G., Xue, Y., Deng, Y., ... & Zhou, J. (2018). Soil bacterial diversity and community composition respond to long-term fertilization. Soil Biology and Biochemistry, 116, 302-310.

Cite this article as :

K. Jyothi, Prof. G. Shankar Lingam, "Soil Conditions an Effective Model Predicts Plant Diseases", International Journal of Scientific Research in Science and Technology (IJSRST), Online ISSN : 2395-602X, Print ISSN : 2395-6011, Volume 10 Issue 3, pp. 908-913, May-June 2023. Available at doi : https://doi.org/10.32628/IJSRST523103158

Journal URL : https://ijsrst.com/IJSRST523103158