Exploring the Role of Machine Learning in Advancing Crop Disease Detection

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Abstract: Crop infections are a significant issue in agriculture, impacting the quality and quantity of produce. Crop diseases can reduce crop output, resulting in lower yields and financial losses for farmers. Research on disease control has been conducted in various scientific and technological fields. The study examines machine learning methods for detecting plant diseases utilising multiple data sources, such as IOT and image technology. Effective disease control has been demonstrated by the tremendous potential presented by technological advancements in sensors, data storage, processing power, and artificial intelligence. In Maharashtra, soybean is cultivated on a large scale and is a highly popular crop. This paper focuses on the study of various soybean diseases prevalent in the region. Using data from various sensors and machine learning to develop models for detection, prediction, analysis, and assessment is becoming increasingly important, according to the research. The growing number and variety of research papers need a literature assessment to inform future advances and contributions. In this paper machine learning methods are used. This article discusses how soybean diseases can be detected using various Machine learning algorithms and can improve plant health status prediction from diverse data sources. The study ends with a discussion of some contemporary issues and research trends.

1 INTRODUCTION

The issue of crop disease has garnered considerable attention recently due to its direct influence on the food supply. Pests and diseases are a key barrier to achieving optimal productivity. Therefore, it is crucial to develop effective methods for the automated identification, diagnosis, and prediction of pests and diseases affecting agricultural crops. The utilization of Machine Learning (ML) techniques is crucial for extracting insights and correlations from the datasets being examined. The main aim of this research is to promote the progress of smart agriculture and precision farming by advocating for the implementation of methodologies that empower farmers to minimize the use of pesticides and agrochemicals while maintaining and enhancing crop yield quality. As indicated by the FAO (HAJIMORAD, DOMIER, et al. , 2018), pest infestations and plant diseases are recognized as key factors contributing to the reduction of food supply and sanitation. The occurrence of plant ailments displays seasonal variations influenced by the presence of pathogens, environmental conditions, and crop types. Crops can face stress from various factors, including abiotic (drought, waterlogging, salinity), biotic (insects, pests, weeds, viruses), and climate change (Dixit, Kumar, et al. , 2023). Pathogens are living organisms that induce diseases, such as viruses, bacteria, or fungi. The impact on crops can vary from minor physiological abnormalities to complete plant death, depending on the specific disease and growth stage.

Plant diseases can result from biological and physical factors, including climate change. Pesticides are used to control damage but can harm the environment, kill beneficial insects, and lead to resistance. Identifying sick plant areas can reduce pesticide use. Traditional methods for diagnosing plant diseases rely on visual inspections and chemical assays, which are labor-intensive and require significant human resources.

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2 MACHINE LEARNING MODELS

Machine learning models help researchers understand data and find out how factors lead to crop diseases and pests. They process data and identify important features to perform tasks like classifying and predicting. In classification, the model labels new data based on what it learned before, while in prediction, it estimates values from input data. By using large amounts of data, such as images, environmental conditions, and plant health measurements, these models can detect and diagnose crop diseases, often before symptoms appear. Techniques like Convolutional Neural Networks (CNNs) are great for analysing images, while Support Vector Machines (SVM) and Random Forests handle structured data well. These models learn from examples, making them accurate in predicting diseases. Using machine learning in farming helps detect diseases more accurately and quickly, reducing crop loss and improving yields.
The following machine learning models show how these algorithms work for detecting crop diseases and their accuracy.

2.1 Support vector machine (SVM)

SVM is a machine learning model that creates a boundary (called a hyperplane) to separate two classes of data. SVM can efficiently classify disease symptoms based on features extracted from images or sensor data, enabling accurate and timely identification of issues affecting crops.

2.2 Random Forest(RF)

Random Forest is a popular machine learning method that uses many decision trees to make accurate predictions. Random Forest is particularly good at handling complex data and can accurately determine if a crop is healthy or diseased.

2.3 K-Nearest Neighbours (KNN)

The k-Nearest Neighbours(k-NN) algorithm is a straightforward and intuitive method used for both classification and regression tasks. One of the key features of k-NN is its simplicity, as it does not require a complex model-building phase.

2.4 Convolution Neural Networks (CNNs)

Convolution Neural Networks (CNNs) are a type of deep learning algorithm particularly effective for analysing visual data, such as images of crops. In crop disease detection, CNNs can sort images of plant leaves into categories such as "healthy" or "diseased" based on these features.diagnosis.
immediate adjustments and reduce the need for remakes. Additionally, AI-powered software can predict the longevity of restorations by analysing wear patterns and material properties, helping to optimize treatment plans.

3 CROP DISEASES

In India, crop diseases are increasing significantly, especially in Maharashtra, where the situation is more severe. This rise in diseases is leading to more crop infections and reduced yields. In Maharashtra, soybean is one of the most common crops affected by these issues. Table 1 outlines the favourable conditions that contribute to the spread of diseases in soybeans. In this section, we discuss the diseases that affect soybean crops. The evolution of publications in crop disease detection models is shown in fig 1. later, it covers how machine learning algorithms can detect these soybean diseases and the accuracy they provide in doing so.

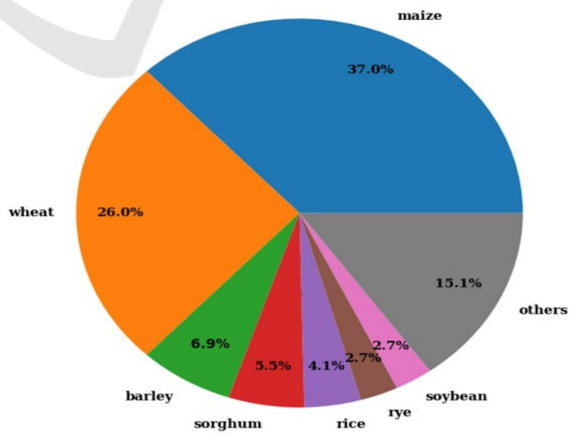

Figure 1: Crop Research Distribution by Focus Area

Table 1: Favourable conditions for disease spread in soybean.

Disease	Temperature (°C)	Moisture	Wetness Duration
Soybean Mosaic Virus (SMV)	20–30	High	Indirect (Aphid activity)
Soybean Cyst Nematode (SCN)	25–30	Moderate	Indirect (Soil conditions)
Frogeye Leaf Spot	22–30	High	6–12
Brown Spot	22–28	High	≥8
Soybean Rust	15–30	High (>90%)	6–8
Leaf Spot Diseases	25–30	High	6–12

4 LITERATURE REVIEW

4.1 SMV detection in soybean

Soybean Mosaic Virus (SMV) is a major threat to soybean crops, causing yield losses and poor seed quality. It spreads through aphids and infected seeds, leading to symptoms like leaf mottling, stunted growth, and reduced pods. Researchers are working on breeding resistant soybean varieties, improving pest control, and developing diagnostic tools for early detection.

In paper (Guia, Feia, et al. , 2021), the author introduced an Novel approach combining hyperspectral imaging with a CNN-SVM model to detect and grade Soybean Mosaic Virus (SMV) severity into three levels. The CNN-SVM model achieved 96.67% training accuracy and 94.17% test accuracy, outperforming standalone CNN models, especially with smaller sample sizes. This method proved effective in handling limited data and addressing hyperspectral redundancy, with potential for early-stage disease detection. Future research could explore the model's scalability for field conditions and its application to other crop diseases.

The methodology employed in the study involved utilizing a pre-trained Mask R-CNN model, specifically initialized with the ResNet50 backbone, to detect and segment soybean leaf diseases. The dataset comprised 3,127 RGB images collected from various regions in India, including both diseased and disease-free leaves. The model was fine-tuned on this dataset, and its performance was evaluated using a separate test dataset. The detection accuracy was assessed at different confidence levels, revealing a maximum accuracy of over 85% at a minimum confidence level of 0.90.

This study (Cui, Chen, et al. , 2011)] employs optimized Convolutional Neural Networks (CNNs) with transfer learning using pretrained models like AlexNet and GoogleNet to detect soybean mosaic virus (SMV). The models, trained on 649 diseased and 550 healthy soybean leaf images, achieved accuracy rates of 98.75% and 96.25%, respectively, demonstrating their potential for early and precise disease detection. Future directions include creating mobile applications for real-time diagnosis on low-power devices and extending the approach to cover other diseases and pests, promoting sustainable agriculture and enhanced crop yields.

4.2 Charcoal rot detection in soybean

Charcoal rot, caused by the fungus Macrophomina phaseolina, is a significant disease affecting soybeans, especially in hot and dry areas like Maharashtra, India. It results in early leaf loss, stem rot, and root decay, hindering the plant's ability to absorb water and nutrients. The fungus's ability to persist in soil makes it challenging to manage. Research is focused on developing resistant soybean varieties, understanding the fungus's genetic traits, and improving soil management practices. Advanced methods and field trials are crucial for detecting and controlling the disease more effectively.

This study uses machine learning (ML) to detect and classify charcoal rot in soybean plants caused by Macrophomina phaseolina. With a dataset of 2,000 plants, ML models achieved 95.76% accuracy, highlighting ML's potential for early disease detection and better crop management. However, the small dataset limits generalizability. Future research could expand the dataset and explore other features or algorithms, with ML offering farmers valuable insights for combating diseases like charcoal rot.

This paper (Khalili, Kouchaki, et al. , 2020) predicts charcoal rot in soybean crops using machine learning (ML). The study used a dataset of 2,000 healthy and infected plants, with physiological and morphological features as inputs. Gradient Tree Boosting (GBT) outperformed other classifiers, achieving 96.25% sensitivity and 97.33% specificity. The research suggests combining disease models with domain knowledge for automated early detection systems, improving disease management, reducing pesticide use, and enhancing crop sustainability, thereby minimizing economic losses and improving agricultural practices.

The study (Nagasubramanian, Jones, et al. , 2018) used Genetic Algorithm (GA) and Support Vector Machine (SVM) to identify charcoal rot disease in soybeans early, with hyperspectral imaging selecting six optimal bands from 240 wavelengths. It achieved 97% accuracy and an F1-score of 0.97, with early detection possible by day three post-inoculation. Future plans include testing in field conditions and expanding to diverse soybean genotype.

4.3 Soybean Brown Spot detection in soybean

Soybean Brown Spot, caused by Septoria glycina, affects crops worldwide, particularly in Maharashtra, India. It causes brown spots on leaves, leading to early leaf drop and reduced photosynthesis. The disease thrives in warm, humid conditions and can reduce yields if it strikes early. Researchers are working on resistant soybean varieties, better fungicide use, and farming practices to manage the disease. Technologies like remote sensing and AI are also being used for early detection and timely intervention.

This research (Miao, Zhou, et al. , 2023) focuses on detecting soybean diseases, particularly brown spot, using a deep learning framework. It involved preprocessing images with the Grabcut algorithm and segmenting lesions using HSI and Lab color spaces for better accuracy. A CNN with continuous layers and sparse Maxout units was developed to improve feature extraction and reduce overfitting, achieving 94.87% accuracy. However, the complex CNN structure increases computational demands. Future work could focus on dimensionality reduction to improve efficiency without losing accuracy, highlighting the potential of AI in crop disease management.

This study (Bhujbal, Mandale, et al. , 2023) presents a method for detecting soybean brown spot using image processing and deep learning. High-definition images are processed to remove backgrounds using the Grabcut algorithm, and lesions are segmented using HSI and Lab color spaces. A convolutional neural network (CNN) with a sparse Max-out activation function enhances feature extraction and minimizes overfitting. The model outperformed traditional methods, achieving high accuracy. Future work includes extending this approach to other crop diseases, improving efficiency, and developing real-time applications for better agricultural management.

The paper (Kashyap, Shrivastava, et al. , 2022) introduces a deep learning-based system for detecting soybean foliar diseases using a Convolutional Neural Network (CNN). It employs a dataset of soybean leaf images that are preprocessed and augmented to enhance model performance. The system shows high accuracy in detecting disease, outperforming traditional methods. Future directions include adapting the model for other crops, integrating it with IoT for real-time disease monitoring, and applying it in precision agriculture for targeted treatment, ultimately improving crop health and management.

4.4 Soybean rust detection in soybean

Soybean rust, caused by Phakopsora pachyrhizi and Phakopsora meibomiae, is a significant threat to soybean crops worldwide, reducing both yield and quality. It manifests as reddish-brown spots on the underside of leaves, causing leaf drop and limiting photosynthesis. The disease thrives in warm, humid conditions and spreads rapidly through airborne spores, making it difficult to control. Farmers manage it through resistant varieties, fungicides, and crop rotation. Research focuses on understanding the disease, developing resistant varieties, and improving early detection for better control.

This study (Santana, Otone, et al. 2024) used a 6x3 factorial design to evaluate ML algorithms for classifying Asian soybean rust severity in the 2022/2023 harvest. Hyperspectral analysis (350–2500 nm) identified spectral signatures for healthy and 25% to 50% severity levels. Algorithms like ANN, REPTree, J48, Random Forest, SVM, and Logistic Regression were tested, with SVM showing the best accuracy. Future work could explore more ML techniques, environmental factors, and real-time data for better disease management.

This study (Ferraz, Santiago, et al. , 2024) employs UAV-mounted multispectral sensors and the Random Forest algorithm to assess defoliation caused by Asian soybean rust in soybean plants. Key inputs, including vegetation indices (e.g., WDRVI, MPRI) and spectral bands (red-edge, NIR), achieved 94% accuracy, highlighting the potential of this approach for precise crop health monitoring. Future work could adapt this method to other diseases and agricultural settings

The Research work (Dixit, Kumar, et al. , 2023) presents a deep learning approach for detecting soybean leaf diseases in two major Indian regions.

The methodology involves collecting a dataset of soybean leaf images, followed by preprocessing and augmentation, with a Convolutional Neural Network (CNN) used for disease classification. The model achieves high accuracy in identifying diseases like bacterial blight and downy mildew, with strong performance metrics including precision and recall. Future directions include integrating the system with mobile apps and drones for real-time disease monitoring, as well as expanding the model's use to other crops for broader agricultural application.

4.5 Frogeye leaf spot detection in soybean

Frogeye leaf spot, a disease triggered by the fungus Cercospora sojina, is a major problem for soybean crops. It causes round, grayish spots with dark edges on the leaves, which can make the leaves drop off early and lower the plant's ability to make food. This disease spreads in warm, humid conditions and is carried by wind and rain. To manage frogeye leaf spot, farmers use soybean varieties that resist the disease, apply fungicides, and rotate crops to keep the fungus in check. Research is looking into the different types of the fungus, developing more resistant soybean varieties, and creating better ways to predict when the disease might strike. These efforts are important for managing frogeye leaf spot and protecting soybean crops.

The paper (Shelke, Degadwala, et al. , 2024) introduces a Conv-LSTM model for multi-class classification of soybean leaf diseases, combining CNNs for spatial features and LSTMs for sequential patterns. Using preprocessed image data, the model achieves high accuracy in identifying various diseases. Future scope includes real-time deployment with drones and IoT devices and extending the approach to other crops and environments for broader agricultural use.

This study explores a machine learning approach for detecting soybean leaf diseases using algorithms like Support Vector Machines and Random Forest. After preprocessing the image dataset and extracting key features, the model achieves high accuracy in disease identification. Future plans include integrating the system into mobile platforms for farmer accessibility and expanding its application to other crops.

The study (Bouaafia, Ahmed, et al. , 2024) introduces a cost-effective deep learning approach using CNNs to detect and localize leaf diseases from image datasets with high accuracy. It aims to enhance agricultural practices, with future plans to expand disease coverage, improve real-time detection, and deploy in field conditions.

4.6 The Soybean Cyst Nematode detection in soybean

The Soybean Cyst Nematode (SCN) is a major threat to soybean crops, attacking roots and causing poor growth, yellowing, and reduced yield. SCN forms cysts on roots, containing eggs that can survive in soil for years, making it hard to control. Infestations can cause crop losses of 10% to 30%. Management includes crop rotation, using resistant soybean varieties, and integrated pest management (IPM). As SCN can adapt, research is focused on genetic resistance, biological control, and molecular techniques to develop more effective control methods.

The paper (Jjagwe, Chandel, et al. , 2024) evaluates the impact of nematode infestations on soybean yields using aerial multispectral imagery and machine learning. Drone capture multispectral data to identify crop stress, and machine learning models analyze this data to classify infestation levels and estimate yield losses. The approach achieves high accuracy in detecting nematode effects, offering a scalable solution for large-scale monitoring. Future scope includes improving model precision, expanding to other crop pests, and integrating the system into real-time pest management frameworks.

The paper (Santos, Bastos, et al. , 2022) examines the use of remote sensing and machine learning to detect nematode damage in soybean crops. By analyzing multispectral imagery with machine learning models, the study accurately identifies stress caused by nematodes. Future directions include refining the model, expanding its application to other crop stressors, and integrating it into real-time monitoring systems for better crop management.

The paper (Akintayo, Lee, et al. , 2016) introduces an end-to-end convolutional selective auto encoder for detecting soybean cyst nematode eggs. This deep learning model effectively highlights key features of eggs while reducing noise, resulting in high detection accuracy. Future work focuses on improving scalability, applying the method to other nematode species, and integrating it into real-time agricultural pest monitoring systems.

5 DISCUSSION

As discussed Soybean is one of the most widely cultivated crops globally, serving as a vital source of protein and oil. However, the productivity and quality of soybeans are significantly affected by various diseases, such as rust, mosaic virus, charcoal rot, brown spot. Accurate and early detection of these diseases is critical to minimizing crop losses and ensuring crop yield. Based on the review of soybean crop diseases it is observed that CNN models consistently perform better than Mask R-CNN for SMV detection (Guia, Feia, et al. , 2021), (Cui, Chen, et al. , 2011). The highest accuracy 96.25% is achieved by CNN with a dataset of 1199 images for SMV detection. A CNN-based model achieves 95.76% accuracy for charcoal rot disease (Khalili, Kouchaki, et al. , 2020), (Nagasubramanian, Jones, et al. , 2018) while sensitivity and specificity metrics for another dataset (2000 samples) are reported as 96.25% and 97.33%, indicating high reliability. CNN models are primarily used, achieving up to 94.87% accuracy for brown spot detection (Miao, Zhou, et al. , 2023), (Bhujbal, Mandale, et al. , 2023), (Kashyap, Shrivastava, et al. , 2022) .Random Forest (RF) achieves95% accuracy, while SVM utilizes hyperspectral images for Rust detection (Santana, Otone, et al. 2024), (Ferraz, Santiago, et al. , 2024).

6 CONCLUSION

In Machine learning is becoming essential for detecting crop diseases, significantly improving agricultural productivity. By analysing large datasets, these models can accurately diagnose diseases like rust and leaf spot, with accuracy rates up to 98%. However, the effectiveness of these models can vary due to factors like data quality and regional differences in disease symptoms. As machine learning technologies advance, they could be utilized to develop models that analyse soybean images and other relevant data to detect SMV symptoms more accurately and efficiently. While promising, continued research is needed to enhance the accuracy for different methodologies of machine learning models across different crops and conditions, ultimately supporting more sustainable farming practices.

7 FUTURE SCOPE

The future scope includes exploring advanced models like Vision Transformers and hybrid approaches to improve accuracy across various soybean diseases. Enhancing datasets with diverse inputs, such as multispectral and hyperspectral images, can improve the ability of models to generalize and accurately identify diseases. These advanced imaging methods offer detailed spectral data, allowing models to better differentiate between healthy and affected plants.

REFERENCES

M. R. HAJIMORAD1, L. L. DOMIER2, S.A. TOLIN3, S.A.WHITHAM4 AND M. A. SAGHAIMAROOF5, “Soybean mosaic virus: a successful poty virus with a wide distribution but restricted natural host range”, MOLECULAR PLANT PATHOLOGY (2018) 19(7), 1563–1579.

S Dixit, A Kumar, A Haripriya, K Bohre, K Srinivasan, “Classification and recognition of soybean leaf diseases in Madhya Pradesh and Chhattisgarh using Deep learning methods” , 10.1109/PCEMS58491.2023.10136030.

Elham Khalili, Samaneh Kouchaki, Shahin Ramazi and Faezeh Ghanati, “Machine Learning Techniques for Soybean Charcoal Rot Disease Prediction”,Frontiers in plant science ,14 Dec 2020.

S Shelke, S Degadwala, “Multi-Class Recognition of Soybean Leaf Diseases using a Conv-LSTM” , https://doi.org/10.32628/CSEIT2410217

Sahil Bhujbal, Pradnya Mandale, Vaishnavi Aher, Rushikesh Wable , “Soybean Leaf Disease Detection” , International Journal for Research in Applied Science & Engineering Technology (IJRASET) .

D.C. Santana, J.D.d.Q. Otone, F.H.R. Baio, L.P.R. Teodoro, M.E.M. Alves, C.A. da Silva Junior, P.E. Teodoro, “Machine learning in the classification of asian rust severity in soybean using hyperspectral sensor, Spectrochim. Acta A Mol. Biomol. Spectrosc. 313 (2024) 124113.

Preeti Jha, Aruna Tiwari, Neha Bharill, “Machine learning algorithm for soybean leaf disease detection”,Journal of Oilseeds Research, 40 (Specialissue).

Jiangsheng Guia, Jingyi Feia, Zixian Wua, Xiaping Fub, Alou Diakitea ,“Grading method of soybean mosaic disease based on hyperspectral imaging technolog” , Information Processing inAgriculture 8 (2021) 380–385.

M. Kumar , N. S. Chandel , D. Singh and L. S. Rajput, “Soybean Disease Detection and Segmentation Based on Mask-RCNN Algorithm” , Journal of Experimental Agriculture International.

Adedotun Akintayo, Nigel Lee, Vikas Chawla, “An end-to-end convolutional selective autoencoder approach to Soybean Cyst Nematode eggs detection" arXiv:1603.07834v1 [cs.CV] 25 Mar 2016

Xiaoyan Cui, Xin Chen and Aiming Wang, "Detection, Understanding and Control of Soybean Mosaic Virus", Soybean - Molecular Aspects of Breeding.

Letícia Bernabé Santos , Leonardo Mendes Bastos, Pedro Luiz Martins Soares 5, Ignacio Antonio Ciampitti , Mailson Freire de Oliveira , andRouversonPereira da Silva, "Identifying Nematode Damage on Soybean through Remote Sensing and Machine Learning Techniques", Agronomy 2022, 12, 2404. https://doi.org/10.3390/agronomy12102404

P Jjagwe, AK Chandel, DB Langston, "Impact Assessment of Nematode Infestation on Soybean Crop Production Using Aerial Multispectral Imagery and Machine Learning", Appl. Sci. 2024, 14(13), 5482; https://doi.org/10.3390/app14135482.

Y Kashyap, SS Shrivastava, R Sharma, "An Improved Soybean Foliar Disease Detection System using Deep Learning" 2022 IEEE Conference on Interdisciplinary Approaches in Technology

Marcelo Araújo Junqueira Ferraz, Afrânio Gabriel da Silva Godinho Santiago, Adriano Teodoro Bruzi, Nelson Júnior Dias Vilela, Gabriel Araújo e Silva Ferraz, "Defoliation Categorization in Soybean with Machine Learning Algorithms and UAV Multispectral Data" ,

Koushik Nagasubramanian , Sarah Jones, Soumik Sarkar , Asheesh K. Singh , Arti Singh , Baskar Ganapathysubramanian , "Hyperspectral band selection using genetic algorithm and support vector machines for early identification of charcoal rot disease in soybean" , Plant methods, 2018•Springer .

Adeboye, O.B.; Schultz, B.; Adekalu, K.O.; Prasad, K. Modelling of Response of the Growth and Yield of Soybean to Full and Deficit Irrigation by Using Aquacrop. Irrig. Drain. 2017, 66, 192–205. https://doi.org/10.1002/ird.2073.

B Tej, S Bouaafia, OB Ahmed, MA Hajjaji, A Mtibaa, "Affordable Deep learning-based Leaf Disease Detection and Localization for Precision Agriculture" , 2024 IEEE 7th …, 2024 - ieeexplore.ieee.org

Yousfi, S.; Marín, J.; Parra, L.; Lloret, J.; Mauri, P.V. Remote Sensing Devices as Key Methods in the Advanced Turfgrass Phe notyping under Different Water Regimes. Agric. Water Manag. 2022, 266, 107581. https://doi.org/10.1016/j.agwat.2022.107581.

Tiago Domingues , Tomás Brandão , andJoãoC.Ferreira , "Machine Learning for Detection and Prediction of Crop Diseases and Pests: A Comprehensive Survey" , Agriculture 2022, 12, 1350..

MaryamOuhami , Adel Hafiane , Youssef Es-Saady , MohamedElHajji and Raphael Canals, "Computer Vision, IoT and Data Fusion for Crop Disease Detection Using Machine Learning: A Survey and Ongoing Research" , Remote Sens. 2021, 13, 2486.

E. Miao, Guixia Zhou ,andShengxue Zhao, "Research on Soybean Disease Identification Method Based on Deep Learning" , Hindawi Mobile Information Systems.

Dr. Nanda Ashwin, Uday Kumar Adusumilli, Prof. Kemparaju N, Lakshmi Kurra , "A Machine Learning Approach to Prediction of Soybean Disease" , doi : https://doi.org/10.32628/IJSRSET219416Research, 99, 1–5.