

Diseases of Sugar Cane and Diseases Classification: The Review

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Abstract — Sugarcane's importance in India stems from its role as a vital cash crop providing raw materials for a large agro-based industry, generating significant employment and income for farmers and laborers, and contributing to the national economy through sugar, jaggery, and ethanol production. As the source of the second-largest agro-based industry after textiles, it supports rural economies, offers export potential, and contributes to India's goal of producing bio-fuels and saving foreign exchange by reducing crude oil imports through ethanol blending. The productivity and quality of sugarcane, a crucial commodity for the world's sugar industry, are greatly impacted by a number of illnesses. Effective management and prevention methods depend on fast and accurate disease detection. To find problems like rust, red rot, mosaic, wilt, and ratoon stunting disease, sugarcane disease detection uses both conventional visual examination and contemporary machine learning (ML) approaches, especially deep learning for image analysis. Deep learning (DL) models, trained on images of diseased leaves, can predict diseases with high accuracy (e.g., 96%), enabling farmers to take timely action using mobile applications to mitigate losses.

Keywords: Sugar cane, Machine Learning, Convolutional Neural Networks (CNNs), Deep Learning, Support Vector Machine (SVM)

I. INTRODUCTION

Sugarcane diseases are a significant threat to cultivation, caused by pathogens like fungi, bacteria, viruses, and phytoplasmas, and they lead to substantial yield losses and degeneration of varieties. Key diseases include Red Rot, characterized by discolored stalks and hollow cavities; Wilt, causing internal tissue discoloration and pithiness; Pokkah Boeng, a fungal disease affecting the top portion of the plant with twisting leaves and shortening internodes; and Grassy Shoot, a phytoplasmal disease resulting in multiple shoots. Managing these diseases is crucial and involves using disease-resistant varieties, heat treatment for seed canes, and improved cultural practices to protect the crop.

The quick advancements in digital technology have made it easier to take pictures of scenes. It has been the main cause of the development of smartphone-based real-time systems. Almost every industry has been addressed, including manufacturing, production, food, health, and finance. Despite this change, agriculture is still the same. The impact of digitalization is evident in several key areas, such as smart cultivation techniques, plant growth monitoring, plant harvesting, etc. However, plant diseases continue to be a major danger to the world's food security and have a declining effect on agricultural productivity. To lessen the negative effects of the diseases, it is crucial to identify them and apply control measures. Controlling these losses can be greatly aided by early diagnosis of plant diseases. Farmers can use the digital information pool to contact digital centers and ask

specialists and plant pathologists for assistance in obtaining the appropriate treatments. Nevertheless, manual illness detection is inaccurate and time-consuming. Numerous academics have looked into ways to automatically identify plant diseases using machine learning and image processing techniques. The main goals of these methods were to increase classification accuracy and decrease diagnosis delay. Fuzzy systems, dimensionality reductions, and picture manipulation techniques were used to guarantee better diagnosis outcomes. Deep learning methods have been more widely applicable in recent years. Systems for diagnosing plant diseases have been discussed for a long time and are regarded as a standard approach to the identification and categorization of plant diseases.

Sugarcane illnesses are identified and categorized using machine learning, namely the Support Vector Machine (SVM) algorithm, which analyzes visual characteristics including color, texture, and shape. These systems use machine vision and image processing to extract features from leaf images, which are subsequently fed into an SVM model for classification. Although SVMs are useful, some research combines them with deep learning models, such as Convolutional Neural Networks (CNNs), for increased scalability and accuracy, sometimes attaining scores above 95%.

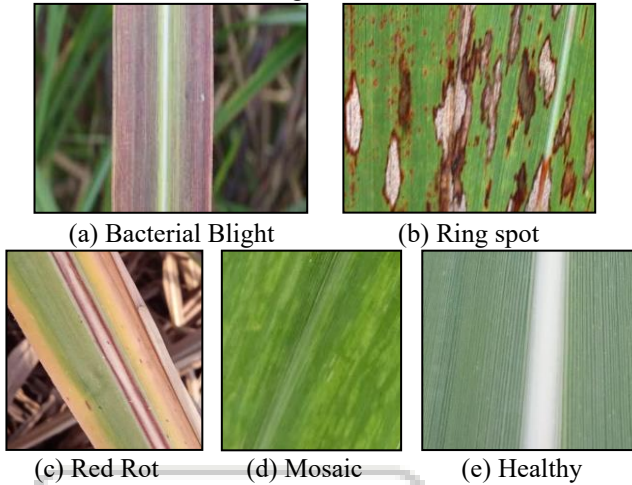
II. SURVEY OF DISEASES OF SUGAR CANE

A significant commercial crop grown for the manufacture of sugar and ethanol is sugarcane (*Saccharum officinarum* L.). However, a number of illnesses brought on by bacteria, viruses, fungi, and phytoplasmas have a substantial impact on its productivity.

Type	Disease Name	Symptoms	Mode of Spread / Transmission
Fungal	Red Rot	Red discoloration of internal tissues, foul smell, drying of canes	Through infected setts, crop residues
	Smut	Whip-like black structure (sori) from cane tops	Wind-borne spores, infected setts
	Ring Spot	Brownish circular lesions on leaves	Wind and rain splashes
Bacterial	bacterial leaf blight	Reddish-brown stripes on young leaves	Infected sugarcane setts, contaminated soil via rain splash and wind.

	Leaf Scald	White streaks on leaves, wilting, leaf drying	Through infected planting material
Viral	Mosaic	Mosaic pattern of light and dark green patches on leaves	Through infected setts, aphid vectors

Table 1: Few sugarcane diseases list



III. LITERATURE SURVEY

Sandip Thite et. al [1] The dataset provides the "Sugarcane Leaf Dataset," which includes 6748 high-resolution images of leaves. These leaves are grouped into nine disease types, one category for healthy leaves, and another for dry leaves. The diseases covered are smut, yellow leaf disease, pokkah boeng, mosaic, grassy shoot, brown spot, brown rust, banded chlorosis, and sett rot. This dataset has a lot of potential for being used again. It would be very helpful for researchers and professionals who want to develop machine learning tools to identify and classify diseases in sugarcane leaves. The dataset can be used with various machine learning methods, like deep learning, feature extraction, and pattern recognition, to make automated disease detection more accurate and efficient. Because it's freely available, it encourages scientists to work together, speeds up research on disease prevention, and helps increase sugarcane production.

Sarala R et.al [2] To evaluate the health of sugarcane plants by looking at their leaves, stems, color, and other features, this research introduces a new deep learning system. With the growing need for sugarcane and the challenges brought by unpredictable rainfall, diagnosing plant diseases has become more difficult. Because of this, there has been a lot of focus on understanding and managing sugarcane diseases. The authors offer a solution by testing how well two widely used pre-trained deep learning models—VGG19 and ResNet50—work for detecting sugarcane diseases. They measure the models' performance using metrics like sensitivity, error rates, and other indicators. They also create a visual comparison showing how well each model performs based on sensitivity. The positive results show that deep learning can be a powerful tool for early disease detection in sugarcane. This has big implications for farming, as it can

help with better disease management and boost sugarcane production.

Ms. V. Sonia Devi et.al [3] claims that sugar cane is one of the most important agricultural products in the world because it is essential to many different cuisines that are found all over the world. Over the past century, sugar cane has fueled agriculture-driven growth in developing nations like India, where the primary source of foreign income was the sale of agricultural products. The commodity's prices have experienced a sharp decline as a result of both supply-side and demand-side shocks. During these years, farmers frequently lack the funds to hire agricultural advisors for activities like diagnosing and treating leaf diseases as soon as possible. The recommended treatment is a low-cost method that uses simple image processing to identify leaf illnesses in sugar cane plant leaves. This would balance pricing at a median price and make life easier for both landowners and consumers. In this project, a camera is used to take pictures of the impacted leaves. These photos are then altered. further utilizing a variety of techniques, and the essential qualities come from them using a variety of techniques.

A.Vivekreddy et.al [4] A vital crop in the world's agricultural sector, sugarcane makes a substantial contribution to the manufacture of sugar, ethanol, and other byproducts. However, a number of diseases can negatively impact sugarcane quality and production, thus prompt and precise disease detection is crucial. The majority of sugarcane disease detection techniques now in use rely on conventional image classification models, which frequently lack the necessary accuracy and effectiveness, delaying responses and jeopardizing crop health. In order to overcome these constraints, this study presents an innovative and effective comparison of deep learning models that make use of the advantages of several deep learning classifiers, such as Alex net, ResNet18, VGG19, and Densenet201, for improved prediction of sugarcane disease. These illnesses include yellow leaf disease, mosaic, red rot, and red rust. In our method, sugarcane photos are first classified using individual classifiers, and the top-performing classifiers are then identified and compared.

Swapnil Dadabhau Daphal et.al [5] This study introduces a deep learning model that uses attention mechanisms across multiple levels to accurately identify plant diseases, especially those affecting sugarcane leaves. The model integrates features from different levels and applies both spatial and channel-based attention to highlight important areas in images. It achieved an accuracy of 86.53%, which is better than existing models like VGG19, ResNet50, XceptionNet, and EfficientNet_B7, tested on a database created specifically for this study. The results show that using features from all levels is important for image classification and can improve performance even when the dataset is small. This model could help in early detection of plant diseases, enabling faster action to prevent crop damage. Additionally, the model can be used in mobile apps on Android phones, making it easier to classify sugarcane diseases using widely available smartphones.

Lakshmikanth Paleti et.al [6] One of the main issues facing the agriculture sector is the identification of crop diseases. Agriculture, forestry, rural medicine, and other commercial applications all depend on the identification and

categorization of leaves. In precision agriculture, the diagnosis of sugar cane plant leaf disease is necessary for automatic weed identification. In order to identify disease in sugar cane plants, this research presents a novel method for developing a model that uses deep convolutional networks and is based on the classification of sugar cane leaf images. The identification and automatic recognition strategy explores the potential of pre-training using ANN employing k-NN and SVM, followed by CNN-based recognition techniques.

Sammed Abhinandan Upadhye et.al [7] Researchers are turning to AI methods, including Machine Learning and Deep Learning, to really dig into farm info. They're looking at things like how much a crop will yield, what prices folks might pay, and even climate and soil quality. These techniques help in preventing crop damage caused by various factors, including diseases. Sugarcane farmers deal with large amounts of data and need real-time analysis using various computer tools. One modern approach for detecting agricultural diseases is deep neural networks, especially convolutional neural networks (CNNs). We looked into whether a deep learning method using a CNN algorithm could actually work to spot crop diseases. Our main focus was on four diseases that show up in sugarcane in India. We started this study because sugarcane diseases are always changing, and it's hard for farmers to tell what's wrong with their crops.

Avdhut Tarwal et.al [9] Because of good growing conditions, farmers choose to plant sugarcane. Countries like Brazil, India, China, and others rely heavily on sugarcane, which is closely linked to the sugar industry. Sugarcane has the highest commercial value among all crops. However, several diseases can lower the crop's productivity and quality. Sugarcane is the main crop used globally to make sugar and ethanol. If sugarcane diseases aren't spotted and treated quickly, small farmers can lose money because these diseases can spread to other crops and destroy them. This is a serious issue for the sugar industry. Farmers can sometimes spot some diseases by closely examining the leaves, but many remain unnoticed, leading to big financial losses. Knowing the type of disease is important to reduce the damage. The increasing number of diseases and farmers' lack of knowledge about diagnosing and recognizing them led to this project. Using machine learning and deep learning in computer vision provides a solution to this problem.

A. Vivek Reddy et.al [11] The only way to identify plant illnesses is to examine them closely in small regions, which takes effort and frequently results in errors. Disease detection can be more accurate and require less time and effort when done automatically. Brown and yellow spots, late and early scorch, and a variety of bacterial, viral, and fungal infections are common plant diseases. A leaf or plant's color changes must be examined in order to manually diagnose a disease. The goal of this research is to automate disease detection so that individuals can distinguish between healthy and diseased plants more easily. The suggested model extracts and chooses significant elements after first enhancing image quality. The Enhanced K Nearest Neighbor (EKNN) approach is used by the model to categorize leaves as either infected or not. This work proposes a novel model, RbS-EAHE-EKNN-LDC, that combines a specific feature set with EKNN for leaf disease classification, improved adaptive

histogram equalization for image improvement, and region-based segmentation. In order to extract precise features for the classification of diseases or non-diseases, the model uses sugarcane pictures and enhances image quality. The outcomes demonstrate that the proposed model outperforms more sophisticated models currently in use.

P Aakash Kumar et.al [12] The foundation of the nation's economy is agriculture. A major source of sugar, ethanol, and jaggery, sugarcane is a crop of global importance. Diseases that affect the crops are one of the issues the sugar cane business faces. These diseases have the potential to wipe out all nearby crops if they are not detected in time. It is physically difficult to inspect every area of a large farm by hand. Convolution Neural Network (CNN) techniques can be used to solve the problem, and machine learning is the modern approach. The trained model may be given drone photos of every area of the farm to determine the health state. Images of both healthy and sick sugarcane plants, with a variety of diseases in the unhealthy class, are used as secondary data to train the model on Kaggle. Early-stage agricultural diseases are successfully identified by machine learning techniques. This aids the farmer in promptly treating the afflicted area of the farm to prevent the sickness from spreading to the other areas. This study uses the CNN model to forecast sugarcane disease.

IV. CONCLUSION

In present situation, it is difficult for farmers to keep an eye on each plant in the growing area and detect the manifestation of any infection. Even though there have been notable advancements in the diseases detection of sugar cane using, much work remains as according to survey the accuracy of classification maximum reaching 94% which is less. Thus, in terms of covering as many as possible many diseases and improving accuracy above 98%, we should conduct a thorough investigation into novel classification techniques, especially with regard to machine learning and deep learning.

REFERENCES

- [1] Sandip Thite, Yogesh Suryawanshi, Kailas Patil, Prawit Chumchu, "Sugarcane leaf dataset: A dataset for disease detection and classification for machine learning applications", ScienceDirect www.elsevier.com/locate/dib 29 February 2024
- [2] Sarala R, Vishnu Varthini, Swetha Raji T" Sugarcane Disease Detection along Chatbot" (IJERCSE) ISSN (Online) 2394-2320 March 2024.
- [3] Ms. V. Sonia Devi I, Guru Kiran V, Vikas Vidya Sagar, Yashas M P and Yashwanth H M.' Sugarcane Disease Detection Using Deep Learning' © 2024 IJCRT | Volume 12, Issue 5 May 2024 | ISSN: 2320-2882
- [4] A.Vivekreddy, R.Thiruvengatanadhan,M.Srinivas, P. Dhanalakshmi "Artificial Intelligence Framework for Multiclass Sugarcane Leaf Diseases Classification using Deep Learning Algorithms", 'Journal of Theoretical and Applied Information Technology 31st May 2024. Vol.102. No. 10
- [5] Swapnil Dadabhau Daphal, Sanjay M. Koli, "Enhanced deep learning technique for sugarcane leaf disease classification and mobile application integration",

- journal homepage: www.cell.com/heliyon Heliyon 10 (2024) e29438
- [6] Lakshmikanth Paleti, Arava Nagasri, P. Sunitha, V Sandya, T.Sumallika, Prabhakar Kandukuri, K. Kishore Kumar. "Sugar Cane Leaf Disease Classification and Identification Using Deep Machine Learning Algorithms", © Little Lion Scientific Vol.101. No 20 31st October 2023.
- [7] Sammed Abhinandan Upadhye, Maneetkumar Rangnath Dhanvijay, Sudhir Madhav Patil, "Sugarcane Disease Detection Using CNN-Deep Learning Method: An Indian Perspective", Universal Journal of Agricultural Research 11(1): 80-97, 2023
- [8] Swapnil Dadabhau Daphal, Sanjay M. Koli, "Enhancing sugarcane disease classification with ensemble deep learning: A comparative study with transfer learning techniques", www.cell.com/heliyon Heliyon 9 (2023) e18261
- [9] Avdhut Tarwal, Roshan Thankar, Om Deorukhkar, Amey Mestry, Prof.Anushree Deshmukh, "Sugarcane Disease Detection", |e-ISSN: 2319-8753, p-ISSN: 2347-6710| www.ijirset.com Impact Factor: 8.423 Volume 12, Issue 4, April 2023.
- [10] Lakshmikanth Paleti, Arava Nagasri, P. Sunitha, V Sandya, T.Sumallika, Prabhakar Kandukuri, K. Kishore Kumar, "Sugar Cane Leaf Disease Classification And Identification Using Deep Machine Learning Algorithms", publication at: <https://www.researchgate.net/publication/375604513> oct 2023
- [11] A. Vivek Reddy, R. Thiruvengatanadhan, M. Srinivas, P. Dhanalakshmi, "Region Based Segmentation with Enhanced Adaptive Histogram Equalization Model with Definite Feature Set for Sugarcane Leaf Disease Classification", International Journal of Intelligent Systems and Applications in Engineering IJISAE, 2024, 12(1s), 428–442
- [12] P Aakash Kumar, D Nandhini., S Amutha, And S P Syed Ibrahim, "Detection and identification of healthy and unhealthy sugarcane leaf using convolution neural network system", <https://doi.org/10.1007/s12046-023-02309-7> 2023.
- [13] G. Mahesh Reddy, P.Hema Venkata Ramana, Ponnuru Anusha, Battula Kalyan Chakravarthy, Aravinda Kasukurthi, Vaddempudi Sujatha Lakshmi, "A Survey on Sugarcane Leaf Disease Identification Using Deep Learning Technique (CNN)", ISSN: 2321-8169 Volume: 11 Issue: 5 28 February 2023
- [14] Narmilan Amarasingam,*, Felipe Gonzalez, Arachchige Surantha Ashan Salgadoe, Juan Sandino and Kevin Powell, "Detection Of White Leaf Disease In Sugarcane Crops Using UAV-Derived RGB Imagery With Existing Deep Learning Models", <https://www.mdpi.com/journal/remotesensing> 3 December 2022.
- [15] S Dhanusri, K Dharani & G Maheswari, "Overview of Bacterial and Fungal Diseases of Sugarcane and its Effective Management Techniques", <https://www.researchgate.net/publication/374400621> 2022.