Rice Leaf Disease Detection: Advances, Challenges, and Future Directions

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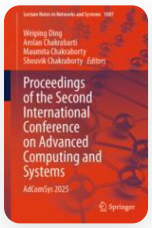

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Abstract

Leaf diseases frequently threaten rice production and quality, impacting the availability of this staple food for more than half of the global population. To create effective

management and control plans, disease detection is crucial. The goal of this literature review was to discuss the latest developments in image processing, machine learning (ML), and deep learning (DL) methods for identifying rice leaf disease. Beginning with basic image processing methods such as contrast, segmentation, and feature extraction, we discuss the significance of increasing detection accuracy in general. Support vector machines (SVMs) and k-nearest neighbors (kNNs), two machine learning methods, were also discussed in this study along with applications for disease categorization using the features that were retrieved. Furthermore, while examining the effects of deep learning models—with a particular focus on convolutional neural networks (CNNs)—we discovered that these models had improved classification accuracy and had an automatic feature extraction method. According to comparative research, deep learning approaches typically outperform conventional machine learning techniques in terms of accuracy and efficacy, particularly when backed with data augmentation strategies. The necessity for sizable annotated datasets and the variability of disease symptoms across different environmental settings are two obstacles that still need to be addressed despite these advancements. Future research is recommended, particularly with respect to the development of generalized models that learn to adapt to varying conditions or incorporating Internet of Things (IoT) technology for real-time sensing. This review serves as a point of reference for other research to continue making these technologies more useful in agricultural interventions, yielding improved rice productivity and world food security.

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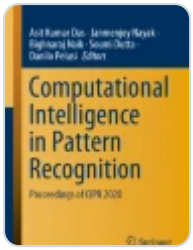

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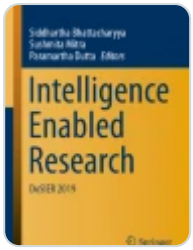

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