

Comparative Analysis of Machine Learning Models for Brown Spot Disease Detection in Rice Leaves

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Abstract

Rice is a vital crop that feeds more than half of the world's population, but its productivity is seriously threatened by diseases like Brown Spot, caused by the fungus *Bipolaris oryzae*. While many studies have shown that Convolutional Neural Networks (CNNs) can effectively detect rice leaf diseases automatically, most focus only on how well a single model performs and often overlook how practical or understandable these models are in real-world use. To overcome these gaps, this study compares several machine learning models CNN, Support Vector Machines (SVM), and Random Forest classifiers using a carefully prepared and augmented collection of rice leaf images to detect Brown Spot disease accurately and efficiently. We measured model performance with common metrics such as accuracy, precision, recall, and F1-score. Additionally, we used advanced explainable AI tools, specifically Grad-CAM and SHAP, to create heat maps that visually explain how the models make decisions. Our findings clearly show that the MobileNetV2-based CNN outperforms the more traditional models, achieving over 94% accuracy. By combining visual explanations and interpretability techniques, this work emphasizes the importance of transparent deep learning models that not only perform well but also gain the trust of farmers and agricultural experts. Overall, we demonstrate that an interpretable deep learning approach provides a powerful, scalable, and clear solution for disease detection in rice farming. In the future, we plan to expand this framework to identify multiple diseases and test its effectiveness in real farming conditions.

Keywords: Brown Spot Disease, Rice Leaf, Machine Learning, Explainable AI, MobileNetV2, Smart Agriculture