

ABSTRACT

Lemongrass (*Cymbopogon citratus*) is a plant widely cultivated for its economic and medicinal value. However, its productivity can be significantly affected by diseases and environmental stress, which manifest through visible changes in leaf conditions. Early and accurate detection of leaf conditions such as healthy, unhealthy, or dried is crucial to support smart agriculture and improve crop management practices. Recent advances in deep learning, particularly convolutional neural networks (CNNs), offer promising solutions for automated plant health monitoring systems.

This study proposes the use of transfer learning and fine-tuning applied to five pre-trained CNN architectures: InceptionV3, Xception, MobileNetV2, ResNet152V2, and DenseNet201, to classify lemongrass leaf conditions. The models were trained in two phases: feature extraction, where the convolutional base was frozen, and fine-tuning, where selected layers were unfrozen for domain-specific learning. Data augmentation techniques were applied to improve generalization. The models were evaluated using accuracy, loss, precision, recall, F1-score, confusion matrix, and ROC-AUC metrics.

The experimental results show that all models achieved high classification accuracy, with significant performance improvements after fine-tuning. DenseNet201 outperformed the other models, achieving a test accuracy of 99.60%, a loss of 0.0136, and perfect macro-averaged precision, recall, and F1-score (1.00). MobileNetV2 demonstrated excellent results with 98.89% accuracy, making it suitable for deployment on edge devices. The findings highlight the effectiveness of CNNs with transfer learning for lemongrass leaf condition classification and their potential integration in smart agriculture systems.

Keywords: Convolutional Neural Network, Transfer Learning, Lemongrass Leaf Classification.