

**The 11th Asian-Australasian Conference on Precision Agriculture (ACPA 11)  
October 14-16, 2025, Chiayi, Taiwan**

## **IDENTIFICATION OF CUCUMBER PESTS, DISEASES, AND DISORDERS USING DEEP LEARNING**

**Wen-Fang Yen<sup>1</sup>, Tsung-Chun Lin<sup>2</sup>, Chu-Ping Lin<sup>2</sup>, Jin-Hsing Huang<sup>2</sup>, Yan-Fu Kuo<sup>1\*</sup>**

<sup>1</sup> Department of Biomechatronics Engineering, National Taiwan University, Taipei, Taiwan

<sup>2</sup> Plant Pathology Division, Taiwan Agricultural Research Institute, Ministry of Agriculture,  
Executive Yuan

\* Corresponding Author: Email: ykuo@ntu.edu.tw

### **Abstract**

Cucumber is an essential economic crop worldwide, which is typically cultivated in summer. The hot and humid conditions make them highly susceptible to various pests, diseases, and physiological disorders, which hinder their growth and lead to significant yield losses. Early and accurate detection is vital to limiting the spread of diseases or pests. However, traditional diagnostic approaches rely heavily on visual inspection by experienced farmers or microscopic examination by specialists, which are often subjective, labor-intensive, and time-consuming. To address these challenges, this study proposes an automated system for identifying pests, diseases, and disorders in cucurbit leaves using deep learning. The system consists of three main components: an anomaly detection module, a pest, disease, and disorder (PDD) identification module, and a chatbot module. A total of 17,711 leaf images were collected in field environments such as greenhouses and open farmland. The anomaly detection module employs a teacher-student framework, using CvT-13 as the backbone and SVM as the classifier. The model achieves a testing accuracy of 100%. For PDD identification, a YOLOv11 object detection model was trained on 4,849 labeled images covering eight common pests, diseases, and disorder found in cucurbit leaves. The model achieved a mean average precision (mAP@0.5) of 0.901. Finally, the two modules are integrated into a LINE chatbot, allowing farmers to conveniently upload images via smartphones. The system shows high potential for supporting field diagnosis of multiple symptoms. Future work will focus on expanding the range of identifiable categories and further improving diagnostic accuracy.

**Keywords:** Pests, diseases, and disorders identification, Cucurbit leaf, Anomaly detection, Object detection

### **INTRODUCTION**

Cucumber is an economically important crop worldwide, with a global production of 28 million tons in 2022. However, cucumber often faces issues from pest, disease, and disorder (PDD) due to their growth in hot, humid conditions, leading to significant crop losses. Effective management of such threats requires early and accurate identification. Conventional diagnostic approaches, such as visual inspection by experienced farmers

or microscopic analysis by plant pathologists, are often subjective, labor-intensive, and time-consuming. To address these challenges, we propose a deep learning-based system for detecting and identifying PDD in cucumber leaves.

## **MATERIALS AND METHODS**

From 2018 to 2024, 17,711 images of cucumber PDD were collected using various devices, including smartphones and digital cameras. These images were subsequently used to train an anomaly detection module and a PDD identification module. For the anomaly detection module, we randomly selected 3,000 images from the dataset as in-distribution data, and 1,000 images from Plantae, a subset of iNaturalist, to represent out-of-distribution samples. For PDD identification module, 4,849 images were annotated with bounding boxes, including eight common types of cucumber PDD.

The system is composed of three modules: anomaly detection module, PDD identification module, and a chatbot module. The anomaly detection module uses a teacher–student learning framework based on CvT-13 (Convolutional Vision Transformer-13) for identifying abnormal leaves. The teacher model is a fixed, pre-trained model that serves as a reference, and the student model is finetuned by the cucumber leaf images. The two extracted feature vectors from the input image are then compared with corresponding mean vectors computed from the normal training set to calculate four Mahalanobis distances. These distances serve as input features to a Support Vector Machine (SVM) classifier, which determines whether the input image is normal or anomalous. The PDD identification module is based on YOLOv11, an object detection model, was used to detect and classify the symptoms in the images. The model was trained on the labeled dataset which is divided into training and validation sets, following an 8:2 ratio. The anomaly and PDD modules were integrated into a LINE chatbot platform, enabling farmers to upload leaf images via smartphone and receive immediate diagnostic feedback.

## **RESULTS & DISCUSSION**

The proposed anomaly detection module achieved a testing accuracy of 100%, successfully distinguishing between healthy and abnormal leaf samples. For symptom classification, the YOLOv11 model attained a mean average precision of 0.901 across the eight predefined classes. However, minor misclassifications were observed in cases where symptoms shared visual similarities or small pests bite marks, indicating a need for more robust training data or multi-label modeling in future iterations.

## **CONCLUSIONS**

This study proposes a deep learning-based system for automated identification of PDD in cucumber leaves. Integrating anomaly detection, a YOLOv11 PDD detector, and a LINE chatbot. The system enables accurate and accessible field diagnosis. The results demonstrate high performance, while future work will focus on expanding the range of identifiable categories and enhancing diagnostic accuracy.