

# A Comprehensive Review of Disease Detection Techniques for Tomato Leaves

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**Abstract:** *Tomato plants play a vital role in global agriculture, significantly impacting food security and economic stability. However, diseases affecting tomato leaves present substantial challenges to crop yields and quality, highlighting the need for effective detection methods. This paper presents a comprehensive review of disease detection techniques for tomato leaves, emphasizing the transformative impact of advancements in image processing, machine learning, and deep learning. Approaches are categorized based on their methodologies, including traditional image processing, machine learning, and cutting-edge deep learning frameworks. Key concepts such as disease segmentation, feature extraction, and transfer learning are defined to provide a foundational understanding. The review also identifies critical research gaps, particularly concerning the generalizability of solutions to real-world conditions and the necessity for computational efficiency in field applications. Organized by method categories, evaluation metrics, and dataset utilization, this review encompasses recent advancements up to 2024, focusing on improving accuracy, scalability, and practical implementation. Ultimately, this work aims to serve as an insightful reference for researchers and practitioners, facilitating the advancement of disease detection systems for tomato leaves for real-world deployment.*

**Keywords:** Tomato leaf disease detection, image acquisition, segmentation, deep learning, machine learning