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Issue Article

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REVIEWING THE PROGRESS MADE IN INTELLIGENT METHODS FOR DETECTING COTTON ILLNESSES

***Abstract**: Cotton is a crucial commodity in global trade, relying on around 100 million rural communities. However, it is susceptible to various diseases, including bacterial, fungal, and viral infections. The majority of cotton plant diseases (80-90%) manifest as leaf diseases. Anthracnose, Alternaria Leaf Spot, Fusarium wilt, Bacterial blight, Boll rot, and insect pests are common. Cotton leaf anthracnose is caused by the fungus Colletotrichum gossypii, which spreads through seeds, soil, and air. It results in boll purple, stem lesions, and seedling lesions. Red boll rot is caused by the fungus Alternaria Macrospora, which causes small, round, brown to tan patches with purple borders. Fusarium wilt affects every stage of the crop, from seedlings to the entire bollard. Angular leaf spot, or bacterial blight, is caused by Xanthomonas citripv. malvacearum and manifests as tiny, water-soaked sores on the stems. Boll rot is caused by a complicated fungal disease that spreads throughout the entire bollard, leading to premature lint decomposition and premature boll closure.*

***Key words**: alternaria leaf, fusarium wilt, bacterial blight, colletotrichum gossypii, fungus, alternaria macrospora, xanthomonas citripv, malvacearum.*
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Introduction

Cotton is one of the most important commodities in global trade. According to the Food and Agriculture Organization (FAO), around 100 million rural communities directly depend on cotton production. Many bacterial, fungal, and viral illnesses are endemic to cotton. Numerous diseases harm cotton leaves, greatly reducing their output. Anthracnose, Alternaria Leaf Spot, Fusarium wilt, Bacterial blight, Boll rot, Insect Pests, etc. are among the illnesses. The majority of cotton plant diseases (around 80-90%) usually manifest as leaf disease.

Cotton leaf anthracnose is caused by the fungus Colletotrichum gossypii. The pathogen primarily spreads through seeds, although it can also spread through soil and air through conidia. In wet weather, the fungus spreads swiftly, resulting in boll purple, stem lesions, and seedling lesions. During harvest, the seeds from diseased bolls contaminate the seeds from good bolls. Because of the cotyledon, damping is one of the early indications of an infestation. The surfaces of the infected leaves contain patches that are very noticeable and pinkish-brown in color. The tissue in large, dry patches surrounding the veins turns from yellow to brown. The fungus that causes red boll rot first appears on the mature capsules as tiny, quickly-expanding reddish-brown patches. The Alternaria leaf spot on cotton leaves is caused by the fungus Alternaria Macrospora. The pathogen is transmitted to healthy plants by soil and airborne spores. Small, round, brown to tan patches with purple borders are the result of early leaf diseases. It is also possible to combine these areas to produce an uncommon dead zone in the center of the blade.

Fusarium oxysporum f. sp. vasinfectum is the pathogen that causes Fusarium wilt to spread. Every stage of the crop is impacted by the illness. The seedlings are first wilted and dry, exposing a brown circle at the base of the leaf. When a plant is young and developing, the first sign is a yellowing of the leaf margins and the area surrounding the roots, or discoloration that begins at the margin and moves to the midrib. The leaves get less turgid, eventually turn brown, droop, and fall off.

Fig. 1 Ramularia leaf spot symptoms in cotton. a) Initial symptoms; Early sporulation of Ramulariopsis pseudoglycines on abaxial (b) and adaxial (c) sides of cotton leaf; d) Detail of an young lesion; e) Late sporulation on necrotic lesions on the lower surface of cotton leaf; f) Detail of a necrotic lesion; g) RLS on the cotton plant; h) Highly susceptible cotton genotype with total defoliation caused RLS; i) RLS Resistant (left) and susceptible (right) cotton genotypes

Angular leaf spot, or bacterial blight, is caused by Xanthomonas citripv. malvacearum. In addition to being transported as seed, it is resistant to plant residues. Both adult plants and seedlings may experience bacterial blight, which manifests as tiny, water-soaked sores on the stems. Because the leaf veins obstruct bacterial migration, lesions typically have geometric shapes. The lesions around Bacterial Blight are more triangular or rectangular in shape than many other cotton-leaf lesions, which are roughly circular. It can be more difficult to distinguish the form from the leaf's age, though.

A complicated fungal disease pathogen causes Boll rot. The illness initially appears as a tiny brown or black stain, but it eventually spreads throughout the entire bollard. Seed and lint decompose when the infection spreads to the interior tissue. The bolls prematurely fell off and never opened. In certain instances, the pericarp may decay externally while the interior tissues remain intact.

The use of computational methods is essential for automating disease diagnosis and control in order to increase cotton yield in terms of both quantity and quality. The users typically used cameras and sensors to obtain images of plant leaves from the cultivated land area. They then proceeded through a series of important phases, such as image preprocessing, Region of Interest (RoI) detection, feature extraction and selection, and classification for the earliest possible plant disease detection.

Cotton is incredibly valuable economically and is essential to the economies of many countries. However, during its whole growth, cotton is continually at risk from a variety of diseases and pests, which can negatively impact cotton's output and quality from the seedling to the harvest stage. The majority of pests and diseases that affect cotton will show up on the leaves of the plant, therefore one of the most widely used methods in agriculture is to diagnose diseases based on changes in the leaves. Nowadays, the majority of farmers make subjective and time-consuming diagnosis based on their own experience or the advice of agricultural specialists. The production of cotton might be impacted by the improper application of insecticides due to misdiagnosed illnesses and pests.

In order to fully classify diseases and pests in photos, early research mostly on traditional machine learning techniques for disease and pest identification. But the majority of conventional machine learning techniques call for manual feature fusion and selection. The model's generalization capacity was weak and the classification effect was not optimal when presented with disparate symptoms of the same illness. Deep learning in agriculture now has greater opportunities thanks to the emergence of Agriculture 4.0 and the widespread adoption of cutting-edge information technologies like big data, artificial intelligence, and cloud computing in the agricultural sector.

Deep learning technology is now making strides in yield prediction, crop classification, crop detection, and other areas of agriculture. Additionally, deep learning classification models have been used to identify specific pests and illnesses that are detrimental to a given crop and spread quickly in order to assist agricultural personnel in the prevention and management of those pests and diseases. However, a number of diseases and pests frequently harm crops at the same time, affecting their overall health. The same plant may be affected by two or more diseases or pests, and growers' demands cannot be satisfied by simply identifying one type of disease or pest.

These studies advanced the study's practical application to agriculture by enabling growers to identify a range of plant diseases and pests using the same model. Furthermore, in certain situations where obtaining photos of illnesses and pests is challenging, their own databases are tiny. Public plant datasets have been directly used as training and testing data in several studies. Several studies trained and adjusted models using transfer learning techniques and public datasets, and all of the outcomes were positive. The aforementioned studies focused more on the identification and categorization of pests and crop diseases in photos than on the actual object detection of pests and illnesses.

In addition to finishing the categorization of pests and diseases on crop leaves, the deep learning-based object detection model also locates the pests and diseases on the leaves in the image. When dealing with several pests and illnesses on the same leaf or inside the same plant, it might increase the accuracy of identification. Assume that accurate object detection of pests and crop diseases can be achieved. In that instance, it will assist in formulating pesticide dosages, applying pesticides precisely, and enhancing crop quality and production. As a result, researchers are beginning to advocate the use of object detection technologies in the fields of disease and pest identification.

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