Updating the Strawberry Disease Smartphone App with Additional Diseases to Improve Diagnostic Performance before Launching

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Summary

Many common strawberry diseases in Florida are caused by fungal pathogens that are managed most effectively with fungicides when they are detected and identified early. We developed a smartphone web-app using artificial intelligence for rapid in-field expert diagnosis of strawberry diseases from images of symptoms taken with the smartphone camera. In 2022-23, we added five additional strawberry diseases to the inventory of symptoms that could be identified by the smartphone app .

Methods

Continued AI model and web-app development

After the proof-of-concept development of the smartphone app in the 2021-22 season, additional digital images of healthy and disease-affected strawberry plants were collected at the Gulf Coast Research and Education Center (GCREC) to expand the diagnostic ability of the app for more strawberry diseases. For diseases that are not present every year, pathogens were grown on isolated plants by artificial inoculation to develop symptoms for image collection. The smartphone app is now trained for 11 classes of leaf conditions: 8 disease symptoms (Leaf scorch, Powdery mildew, Pestalotia leaf spot, Angular leaf spot, Leaf blotch, Bacterial spot, Common leaf spot, Cercospora leaf spot, and Powdery mildew), immune response, Unknown, and Healthy. The updated trained model was deployed to a smartphone web-app after validation and then tested independently in the field.

Results

The web-app performed well in the field and correctly identified most of the symptoms that it was trained for, but we noticed some difficulty in distinguishing Pestalotia leaf spot from Leaf blotch, since their visual symptoms are very similar, and could even be mistaken in the field during data collection. We explored using generative AI methods to create abundant high-quality image data from a small sample (20-30 images) of lab-verified leaf symptoms. This is necessary because it is impossible to verify thousands of symptoms in the field using reliable q-PCR or culturing methods. However, using the lab methods to accurately diagnose 20-30 samples per symptom is feasible, which can then be photographed, trained on a generative AI model, and thousands of new unique authentic images can be generated for training the smarthone app's model. Figure 1 illustrates synthetically generated images of strawberry leaves showing Leaf scorch symptoms, compared to images of real symptoms.

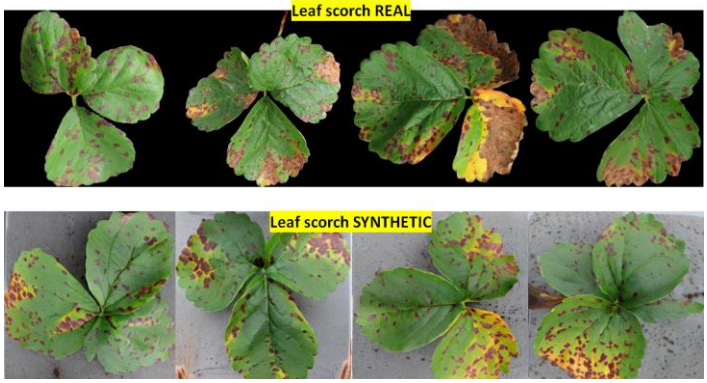

Figure 1. Illustration of synthetic images of Leaf scorch-affected strawberry leaves, compared to real images.

A video of the smartphone web-app can be viewed at

https://www.dropbox.com/s/pxnwe0d2vp6y30g/straw-app.mp4?dl=0. Scan this QR code with your phone camera to view the video.

Final Tasks and Takeaways

We will be testing the prototype smartphone app with a few growers at the beginning of the 2023-24 season. This will provide an opportunity for final validation of the app by sampling in-field disease detections and verifying them in the GCREC disease diagnostic clinic. Additonal synthetic image data will be generated with generative AI models and incorporated into the predictive model to improve performance where needed. After the early season soft launch, we plan to fully launch and support the free smartphone app in the late part of 2023-24 season for free use by growers, scientists, extension agents, consultants, and the general public. We will also run pilot tests for an automated larger-scale image data collection platform for tractor-mounting, which, if successful, will allow for precision disease mapping while conducting routine field operations.

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