Plant reflections may be key to early detection of treatment needs

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When disease and insect problems in crops are visible to the naked eye, it may be too late to treat. That's why Dr. Christian Nansen, Texas AgriLife Research entomologist, likes to take a closer look. A hyperspectral look, that is.

Nansen, small grains entomologist at the Texas AgriLife Research and Extension Center at Lubbock, uses a hyperspectral camera to determine how light is being reflected off plant leaf surfaces. He discussed the technology at the High Plains Vegetable Conference in Canyon.

"Just like when we start having the flu, our body responds and we get a fever," he said. "The fever is because our body is mobilizing its immune system. When a plant undergoes stress caused by diseases, insects or the environment (like drought), it will cause changes in its metabolism and that leads to subtle changes in the way it reflects light.

"We can use this camera to detect stress at an earlier stage than by visual inspection."

For instance, Nansen said, root rot is all underground, and generally plants are half dead when the damage becomes visible.

"But if you could see it earlier, you may have time to treat for the fungus causing the problem," he said.

The hyperspectral camera detects diseases in any plant, Nansen said.

And with insect damage, the key parameter to control is early detection.

“When scouting for spider mite infestation, you have to take a lot of samples to see mites when the infestation level is low,” he said. “But with spectral imaging, you can see it earlier and it is less intrusive.”

The technology is similar to that of remote sensing, Nansen said. However, instead of putting the camera in an airplane, it is placed just over the canopy of a crop, perhaps mounted on a four-wheeled all-terrain vehicle or on the center-pivot irrigation system.

He said his research team is in the early stages of testing the technology. They are starting by collecting spectral profiles of healthy and sick plants and developing classification algorithms.

“We are using it now to do early detection of zebra chip in potatoes and cotton root rot, and also looking at spider mite stress on corn plants,” Nansen said. “We’re developing technology that we hope can work with other programs.”

Currently, potato producers must use visual symptoms of stress in the plants to detect zebra chip, a disease that has no treatment, and determine if a field should be harvested, he said.

“We want to see if we can detect the disease in the actual fields while plants are still growing,” Nansen said.

“With a potato plant, a lot of inputs and resources are needed. If we can detect an infestation early, our technology may help producers decide whether it is worthwhile to spend more resources on a given field and/or whether their potatoes should be sold for chipping or another market.”

He said because it has not been determined what causes the actual

infection, he hopes to be able to use the hyperspectral process to determine when it starts to occur and what is happening with the plant at that time.

“We think we can also obtain a much higher accuracy using the reflectance technology to scan the potatoes and see how it will be after frying,” Nansen said.

The zebra chip effect causes the potato to turn brown after frying, he said. At this time is doesn’t appear to affect quality and does not show up in baking potato, but the discoloration after frying is a problem for the chipping industry.

Another possibility, he said, is to utilize the technology in plant breeding to determine genetic differences in germplasm. Seed analysis is already being done much the same when scientists look for protein content in wheat, oil content in peanuts or maturation of tomatoes.

“We have a wealth of information on reflectance technology available,” Nansen said. “But there are certain characteristics about what we do that are unique.

“We’re trying to make it relevant on a larger scale without being too expensive,” he said. “I think if we can develop some robust classification algorithms, we can do many things and automate the system if it can pass over the field.”

The technology is ripe for someone to put a complete package or system together, Nansen said, because the different computer programs have been written and could be combined into a single program with the proper funding.

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