

Enzyme May Protect Sugar Beets From Leaf Spot Disease

In 2001, U.S. farmers grew more than 25 million tons of sugar beets and provided the country with about half its sugar supply. They also applied thousands of pounds of fungicide to sugar beet leaves to battle leaf spot disease, one of the most widespread diseases affecting the crop.

Leaf spot, which results in root yield loss and reduced sugar content of beets, is caused by the fungus *Cercospora beticola*. Although fungicides help effectively manage the disease, *C. beticola* is developing resistance to some currently in use. This has spurred research into alternate management strategies.

Now, plant pathologist Robert Lartey and microbiologist TheCan Caesar-TonThat of ARS' Northern Plains Agricultural Research Laboratory in Sidney, Montana, may have found a way to combat leaf spot disease using an enemy already in the soil.

When a sugar beet plant is infected with *C. beticola*, the attacking fungus produces a toxin called cercosporin. When the toxin is exposed to light, it reacts with oxygen to produce superoxide anions and singlet oxygen, which are also known as free radicals. These molecules attack the fatty acids that make up plant membranes. Eventually the membranes

rupture, and the plant cells die. If enough plant cells die, the sugar beet's leaves will exhibit the disease's characteristic spots, which are actually colonies of fungi feeding on degraded plant material.

In looking for a biological control agent to use against leaf spot, Lartey and Caesar-TonThat focused their search on other types of fungi. They discovered a few promising species that seemed to inhibit the growth of *C. beticola* and concentrated on a basidiomycete fungus called *Laetisaria arvalis*.

Basidiomycetes are most closely associated with forests and wood decay, but they are actually found in many types of soil, including those on agricultural lands where sugar beets grow. They produce different enzymes that break down lignin and release cellulose and hemicellulose from plants.

Caesar-TonThat and Lartey were able to isolate certain enzymes from the basidiomycete *L. arvalis* and test them in the lab. One enzyme in particular—laccase—worked very well in degrading and detoxifying the cercosporin toxin.

The researchers believe laccase could become an all-natural enzymatic solution for preventing leaf spot disease. Caesar-TonThat explains, "The purpose of the cercosporin toxin on the host plant seems

Cercospora leaf spot disease symptoms on a sugar beet leaf.



to be to provide, indirectly, a food source for the fungal pathogen, *C. beticola*. If we degrade cercosporin with laccase, we may be able to starve the fungus."

Adds Lartey, "Applying some form of the enzyme to sugar beet plants could prevent leaf spot from occurring."

The researchers were so successful with their lab experiments that they filed a patent application on their discovery. Their next step will be to test the enzyme in greenhouse studies and, if those go well, to test it on field crops.—By **Amy Spillman**, formerly with ARS.

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A plane sprays a sugar beet field with fungicide. The fungus *Cercospora beticola*, which causes leaf spot disease, is developing resistance to some fungicides currently used against it.