SRA Researcher Dr Chuong Ngo at SRA's Indooroopilly laboratory.

SRA is working on a trial at SRA Woodford that is hoped to lead to better variety resistance ratings for Chlorotic Streak.

Chlorotic Streak search finds the needle in the haystack

A team effort at Sugar Research Australia has led to the discovery of the organism that causes Chlorotic Streak, which has potential for industry benefits in relation to the disease.

Researchers at SRA have made a major breakthrough in determining the cause of a sugarcane disease that has remained a mystery for almost 90 years.

Chlorotic Streak Disease (CSD) was first recognised in 1929, and since that time there has been considerable research effort from around the world to determine the cause of the disease, how it is spread, and how to manage it.

CSD is a serious and widespread disease of sugarcane. In the worst cases, yield losses can be as much as 40 percent, and it has been estimated to cause an annual loss to the sugarcane industry of $8 to $10 million.

In a major recent breakthrough, SRA Researchers Kathy Braithwaite, Chuong Ngo and Barry Croft have used modern DNA technology and traditional pathology to identify the organism that causes CSD.

By combining DNA sequencing, microscopy and microbiological isolations with their previous success in developing a diagnostic test for CSD, the researchers identified a microscopic organism that is a type of protozoa.

The discovery has been a collaborative effort between multiple SRA staff at Indooroopilly, Woodford and Tully. TCPSL and Sunshine Sugar also contributed to the work by providing samples.

The recent research began with SRA researchers Kathy Braithwaite and Barry Croft reviving CSD research in 2010. It took almost three years, but their work eventually led to Dr Braithwaite developing a successful diagnostic test for CSD.

That work then opened the door to using new DNA sequencing technologies. Dr Chuong Ngo led this part of the research that eventually resulted in the discovery of the organism.

"Because we had the diagnostic test, we were able to be completely sure which plants were healthy and which were diseased," Dr Ngo said. "We then used Next Generation Sequencing technologies to compare the DNA between a healthy sample and an infected sample."

They subsequently had information on all the DNA that was within the two samples. With a vast multitude of DNA within a sugarcane plant – more than just the DNA of cane – the challenge was determining which piece of DNA belonged to the organism that they were searching for.

With hundreds of millions of fragments of DNA to sift through, Dr Ngo said they used high powered computing to help find the needle in the haystack.

Their investigations eventually led them to a group of organisms called protozoans.

"Initially we only had short fragments of DNA, but as the project progressed we identified several full length sequences and were able to get a really good idea of where the organism belongs evolutionarily."

The organism is about one hundredth of one millimetre in size and is distinguished by two flagella (whip-like structures).

SRA researchers are currently working with a protozoan expert, Dr David Bass, from the Natural History Museum in London to help formally name the new organism. They also understand that there is more work to be done.

Because the organism has only just been discovered, there are many questions still to be answered. What is its life-cycle like? Can it lay dormant? Does it have an alternative host? What possible control methods are there? "It is so novel, and nobody has worked on anything like this before. There is so much we have yet to understand about its basic biology," Dr Ngo said.

It is already well understood that CSD transmits via water, and its impact is worst in wet growing regions, while also increasing in severity in wet years. The wet La Nina years around 2010-2012 saw an explosion of the disease in some districts.

But the researchers believe there is much further potential in translating the discovery into further benefits for the Australian sugarcane industry.

Diagnostic test

There has already been interest from some productivity service organisations in the diagnostic test.

Further work is planned to improve the efficiency of the diagnostic test, such as potentially allowing for sampling from leaves.

"The current test works really well on stalks and sap, but our challenge is to turn that test into something that the industry needs and wants and is useful to them," Dr Braithwaite said.

"We hope the test will be useful for productivity services to ensure their seed cane truly is clean."

What it means for industry

To date, the industry has not had reliable disease resistance ratings for CSD. The only way to screen varieties was in field trials, which were reliant on rain and floodwater to spread the disease.

Dry years meant that there were poor trial results, and even in wet years researchers found it difficult to control the trials.

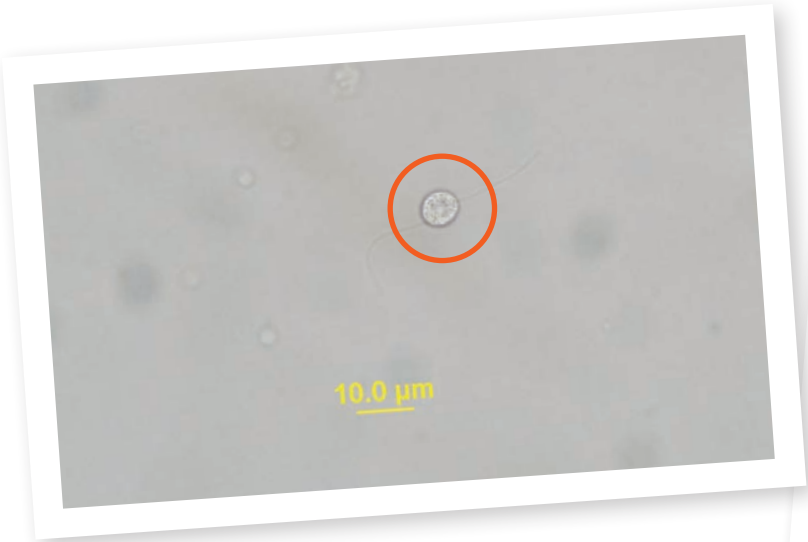
The research team at SRA Tully, led by Dr Rob Magarey, have done much work on variety screening and developed a method of infecting plants via a hydroponic system.

That work is now being taken a step further, as the research team have also been able to successfully grow the organism in culture, which had never before been achieved.

Now that they can produce the organism in the laboratory, they want to develop a rapid reliable infection method to screen sugarcane varieties under controlled conditions. It is hoped that this will lead to reliable disease resistance ratings for our varieties.

"For the industry, there are three big outcomes from our research that we want to deliver: the diagnostic test, which would be useful for productivity services, reliable resistance ratings, which will help growers select the right variety for wet situations, and now that we know what type of pathogen it is, we might be able to develop more targeted control methods," Dr Braithwaite said.

SRA acknowledges the funding contribution from the Queensland Department of Agriculture and Fisheries towards this research activity.



Above left: The Chlorotic Streak organism under the microscope (circled).

Above right: Chlorotic Streak symptoms.