



Industry update

December 2014



Independent Scientific Research Panel update



**Chair of the YCS
Independent Scientific
Reference Panel:
Professor John Lovett**

On 19 November 2014, the Yellow Canopy Syndrome (YCS) Independent Scientific Research Panel met in Townsville with the 21 members of the Program Research Team to discuss research plans, consider new strategies for solving YCS and share findings to accelerate learnings about YCS.

Chair of the YCS Independent Scientific Reference Panel, Professor John Lovett, said the role of the panel was to provide guidance with relevant scientific and technical opinions, assessments and viewpoints to assist investigators with challenges they confront with YCS.

'YCS remains a critical issue for the sugarcane industry. It is for this reason the scientific reference panel and research team continue to investigate YCS as a high priority', he said.

Members of the panel also visited YCS-affected regions in the Burdekin, as well as SRA research stations, productivity service groups and cane farms in Ingham, Tully and Meringa.

New research activities

Sugar Research Australia's Development Officers have been working with productivity service groups throughout the industry to provide three weekly reports on the appearance and severity of Yellow Canopy Syndrome (YCS).

The reports provide a current picture of when YCS is more active, and where it is currently being observed. Collectively, these results are helping to build a greater understanding of the conditions, behaviour and distribution of YCS over time.

YCS in Queensland in the 2014 season



YCS pot trials at SRA Burdekin.

YCS research update

Three research projects forming an integrated research program and funded by SRA and the Queensland Department of Agriculture, Fisheries and Forestry started on 1 July 2014. Each project is investigating different aspects of YCS and, collectively, they are expected to provide complementary information and results that build our understanding of the condition.

Research project 1

Solving the Sugarcane Yellow Canopy Syndrome



Project leader:
Davey Olsen

Lead research organisation: Sugar Research Australia

Collaborations: Burdekin Productivity Services Limited and Herbert Cane Productivity Services Limited on district surveys and mill data comparisons.

Project dates: 2014–2017

Project overview: This project builds on the findings of the first year of research and will focus on a number of promising lines of enquiry. A wide range of research trials will be conducted to understand whether YCS is caused by a living factor such as an unknown disease or pest, or a non-living factor such as high temperatures or water stress. The project will also look at the role stress plays in triggering or increasing the symptoms of YCS and will seek to develop diagnostic tools that can accurately confirm the presence of YCS in an affected plant.

Current activities

Three field trials focusing on soil biology, environmental stress, and Confidor have recently been established in the Herbert region. These trials will help to understand the variable nature of YCS expression throughout the region and will provide further insight into how YCS is triggered in the field.

The SRA team continue to develop methods to reliably induce YCS-like symptoms in controlled pot trials and have been working on measuring the physiological responses and symptom expression in these plants. This work is focused on developing a diagnostic tool for YCS.

Throughout the harvesting season we have worked with our partners – Herbert Cane Productivity Services and Burdekin Productivity Services – to assess the impact of YCS on yield and CCS as blocks are harvested. A full report on findings will be provided early in 2015.

Updates on the YCS research program were also provided at the HCPSSL and BPS Annual General Meetings in late 2014.

Research project 2

What biological factors cause or drive the development of YCS



Project leader:
Dr Frikkie Botha

Lead research organisation: Sugar Research Australia

Collaborations: World-renowned experts from institutes in Australia, Canada, Germany, the United States of America and South Africa on the collection of data and the complex analysis of results.

Project dates: 2014–2015

Project overview: Through a range of biochemical and physiological approaches, this project seeks to understand how YCS affects the internal behaviour of the sugarcane plant. An understanding of what is happening inside the plant may shed some new light on the biological factors that cause or drive the development of YCS.

Current activities

The project aims to pinpoint the specific reactions that lead to the expression of YCS. To achieve this, comprehensive metabolome and transcriptome analyses are being done that will allow the research team to replicate the metabolic pathways in the leaves and stalks during the development of YCS.

The data collected to date shows that the metabolism of YCS-affected plants is compromised throughout the canopy, and in leaves even where there is no visual expression of YCS. Some of these changes might make the crop more vulnerable to some environmental stresses.

The plants that are showing YCS symptoms tend to have higher sugar levels in the leaves. Chlorophyll loss and yellowing seems to reflect a very late stage of development. In addition to the increase in sugar content there are two other changes that might be important. Firstly, there are significant levels of metabolites that are indicative of injured or stressed tissues and secondly, there are significant increases in several caffeoyl/ chlorogenic-type compounds, which are indicative of wounding and activation of plant defence systems.

Research project 3

A novel polyphasic framework to resolve Yellow Canopy Syndrome Paradox



Project leader:
Professor Brajesh Singh

Lead research organisation: University of Western Sydney

Collaborations: International research experts from institutes in Australia, China and the United States of America are collecting and analysing the complex dataset generated from metatranscriptomics and metagenomics and correlating those with YCS development, soil health and plant responses

Project dates: 2014–2016

Project overview: The project will apply a comprehensive 'microbiome'-based approach combining novel next-generation sequencing (Illumina) and conventional cultural techniques to provide broader view of the complexity of organisms present in YCS-affected sugarcane and determine the involvement of biological agent(s) in YCS development. Furthermore, the project will generate key knowledge on the impact of YCS on soil health and host response which will help in understanding YCS facilitation process. This knowledge may lead to the identification of soil health management strategies that growers can use to manage YCS.

Current activities

To provide a comprehensive description of the bacteria present in YCS-affected and healthy cane, next-generation sequencing using Illumina MiSeq has been performed on different samples (leaf, root, stalk and soil) collected at four different time points from Ayr and Ingham. Results are currently being analysed and will be provided in the next Industry update. The protocol for using MiSeq to describe the fungal community is being validated.

A culture collection of 200 microbial isolates from YCS-affected and healthy samples has also been developed. These microbial isolates are being tested for various traits related to plant growth promotion, including phosphate solubilisation, iron chelation, production of plant growth hormones and antagonistic abilities towards pathogenic fungus.

We have optimised a method to determine the salicylic acid content of cane leaves which could be used as a biomarker for YCS detection. HPLC analysis of tissue samples is in progress and the results will be available in next couple of weeks.

The program is being coordinated by Dr Harjeet Khanna, SRA Program Coordinator –YCS, with continued input by the Scientific Reference Panel.



Above: Jaya Basnayake, Angela Zeilstra and Leanne Hayes at the YCS Environmental Manipulation Trial in Ingham. They are downloading data from the weather station.

Researcher profile



Co-investigator:

Dr Pankaj Trivedi,
Research Fellow,
Hawkesbury Institute
for the Environment,
University of
Western Sydney

Background

PhD in Microbiology from Kumaun University Nainital, India. Post-Doctoral Research Fellow at the Department of Microbiology and Cell Sciences, University of Florida. Has worked with the sugarcane (Australia and Florida), citrus (Florida) and grain industries (Australia) for six years.

Project overview

Dr Trivedi is one of the co-investigators working in Research Project 3. With his team, Dr Trivedi is using an advanced 'microbiome'-based approach combining novel next-generation sequencing (Illumina) and conventional cultural techniques to generate knowledge about plant-soil-microbe interactions. This will help to determine the role of sugarcane-associated microbiome, soil health and host responses in YCS development.

To provide a picture of the bacterial diversity in plant and soil samples collected from healthy and YCS-affected plants from the Herbert and Burdekin regions, Dr Trivedi and his team used high-throughput MiSeq Illumina analysis. Dr Trivedi is now applying elaborate bioinformatics analysis to determine the role of biological agents in YCS development.

Approximately 200 bacterial isolates from soil samples have been characterised for various plant growth promotion abilities to develop an important bio-resource of beneficial sugarcane-related bacteria. These bacteria can be used as microbial inoculants to minimise the impact of YCS and provide biological sustainable solutions of sugarcane production.

Members of Dr Trivedi's team are also looking into the differences in salicylic acid content and changes in expression of various stress-related genes in YCS-affected sugarcane.

This research could be a step towards development of physiological and/or molecular markers for predicting YCS incidence. Furthermore, his team is generating key knowledge on the impact of YCS on soil health and host response which will help in understanding YCS facilitation process.

This knowledge will help to build our understanding of the internal behaviour of YCS-affected plants.

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