



# Research gets to the root of the matter

## SUGARCANE ROOTS MAKE UP A LARGE PART OF THE SUGARCANE PLANT, AND RESEARCH WORK IS UNDERWAY TO HELP LIFT THE UNDERSTANDING OF ROOTS IN LINE WITH OTHER PARTS OF THE CROP.

**Roots are the foundation of your crop. They anchor the crop in the ground, they provide nutrient for the plant, and they are a point of contact for pathogens. It is estimated that the roots also consume around half of the energy produced through photosynthesis each day.**

But, until recently, there has been only a limited scientific understanding of this important part of sugarcane, especially in comparison to other agricultural crops.

This is now changing through the work of a recently completed research project led by CSIRO, which has filled important gaps on sugarcane root knowledge for the Australian sugarcane industry and is leading to further research activity.

Led by CSIRO scientists Dr Anne Rae and Dr Johann Pierre, the project has gathered practical information on sugarcane root systems and examined specific issues including anatomy, the structure, varietal differences, and the roots' response to different stress situations.

The researchers have used techniques for analysing roots in other industries and applied them to sugarcane, which has been vital for dealing with a crop with a large biomass – both above- and below-ground.

The complexity and size of sugarcane root systems meant that the project developed innovative ways of measuring and analysing roots, while also determining which measures were relevant to the industry.

"Our new methods for assessing root system structure and architecture compare key features, including root/shoot ratios, root opening angle, root length, proportion of fine roots, branching density and average diameter," explained Dr Pierre. "The first project has been mostly glasshouse based with some field work, and we are extending that information further, including with more field work, to determine how we can use this information to provide valuable information for the industry."

This information from this research will be used in several ways, including for the sugarcane breeding program through SRA, as practical information for growers that can guide practice change, and to form the base for future research that will drive these outcomes even further.

Dr Rae said that one of the important findings from the project was that there were no significant reductions in root system size or quality in sugarcane varieties over time.

"We saw differences between varieties that we are investigating further, but there is no evidence that the work of breeders in selecting for yield has biased current and new varieties toward having smaller root systems than older varieties," she said. She said that this highlighted the range of complex factors that influence ratoon length in the industry.

Future experiments are planned to look at how roots respond over several ratoons.

The work of CSIRO is linking with several other projects within SRA's investment





portfolio, and especially within SRA's Soil Health Program. This program is a 10-year commitment by SRA to work with the industry on building our knowledge around the links between soil health, the farming system, and profitability, and translating this into practical outcomes for growers.

For example, this roots project is linking with the project 2017/015 (*Measuring soil health, setting benchmarks and driving practice change in the sugar industry*) and using some of the paired sites in this project to help understand the baseline of what a good, healthy root system looks like (see page 22).

This information will be useful for growers in understanding the response and role of roots in relation to sugarcane soil health.

In addition to that, the project is also collaborating with other projects to look at ways of easily gathering information on root health.

It has also linked with an Early-Career Researcher award investment by SRA, where Dr Pierre investigated the use of DNA-based technology to investigate a test to diagnose root health. This work through the ECR and the broader roots projects is also collaborating with other

activity led by SRA to develop an overall DNA-based diagnostic – called Predicta – for the sugarcane industry.

Run through the South Australian Research and Development Institute (SARDI), the Predicta test is hoped to incorporate a range of factors that could include pathogens and roots. This has the potential to link back to the other research activities within this program. ■



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*(Over page / Above) Working in the field as part of the CSIRO-led and SRA-funded project investigating root systems in Australian sugarcane.*

#### SOME KEY FINDINGS:

- The research found significant differences between varieties but there were no significant trends towards particular features in the industry's varieties over time.
- Compared to other crops, sugarcane roots appear to be very efficient in terms of the energy cost to maintain a large root system.
- Current varieties have a consistently high proportion of fine roots when grown in optimal conditions, and there is a strong overall relationship between above-ground mass and root volume. These relationships were maintained when the shoot growth was artificially restricted.
- Insufficient nitrogen supply caused stunted shoot growth but directed a larger proportion of resources into the root systems. To maximise the root system length, plants decreased the root average diameter and tended to decrease branching.