## Project details

**Key Focus Area:**

**Optimally adapted varieties, plant breeding and release**

**Project name**

Sugarcane root systems for increased productivity; development and application of a root health assay

**Project number**

2015/002

**Principal provider**

CSIRO

**Project leader**

Dr Anne Rae



# Digging down into the function of sugarcane roots

*A new project is looking at sugarcane roots in relation to genetics, environment, and management, and working toward important new information for the Australian sugarcane industry.* ***By Brad Pfeffer***

What does a healthy and high-performing sugarcane root system look like, and how does it function?

This might seem like a simple question, but a new research project being led by the CSIRO is delving deep into these and many other unanswered questions about sugarcane roots and how they are performing below your soil.

Roots are supposed to be one of the biggest consumers of energy within a sugarcane plant, yet information on their function and structure has, until recently, been limited because of the size of the plant and the opaque nature of the soil.

New digital scanning technology is changing that and allowing researchers to get a clearer picture of sugarcane roots.

Dr Johann Pierre with CSIRO said that work on sugarcane roots was a vitally important area of research because of their huge importance to the crop.

New technologies developed in other crops can benefit sugarcane and build on what we knew previously about roots.

The roots are large. Stretched end to end, he said the roots of a mature sugarcane plant measured about 2km in length.

They also consume a lot of the energy of the plant, consuming up to 50 percent of the photosynthate produced each day just for root respiration.

"About 60 percent of the root length are the very fine roots, which measure less than a quarter of one millimetre in diameter. They are the active pipe supplying water and nutrients to the plant but there is a high metabolic cost to these roots for their growth, maintenance and uptake function.

"So for the plant, it is a question of how it invests its resources. Does it invest in big roots to go deeper and try and access more of the mobile resources such as nitrogen and water, or stay closer to the surface to access more of the topsoil resources?"

He said a better understanding of the plant response in different conditions would have potential for management considerations for growers.

The project, which is funded by Sugar Research Australia, is also investigating the difference in root characteristics between varieties. It is also looking at old varieties and comparing the roots to new varieties such as SRA1$^{\phi}$ to see if the root characteristics have changed over time within the SRA breeding program.

Dr Johann Pierre said that this process started with 20 different varieties grown in large PVC pots that were grown for two months under optimal conditions.

From there, the roots of mature plants were washed free of soil and digitally scanned.

“There were some interesting varietal differences in the way the roots were able to explore the volume of soil around them,” Dr Pierre said. "For example, we found contrasting root-shoot ratios in different varieties.”

The research team are now testing to see if these differences still persist in mature plants and how the number of stalks affects root system biomass and shape. That is hoped to lead to very useful information in relation to how different varieties are performing underground.

For example, growers have already observed and understand that some varieties establish quicker than others. In some cases, the researchers said, this may be because more effort is going into the roots first. The research will also look at how this may advantage those varieties.

Dr Anne Rae with CSIRO said that over the long term, the information from this research is also hoped to be useful for the SRA breeding program.

“The breeding program is selecting highly productive varieties and they all have strong root systems, but there are differences between varieties and we think that those differences might allow some varieties to be better suited to some field conditions or management practices than others,” she said.

“It might seem that a bigger root system is always better, but there is a cost to maintaining a root system for the plant. If a plant puts a lot of resources into a big root system, then perhaps that is a resource that could have gone into sugar. So you need the right balance of a root system that does the job, but without wasting resources.

"At the moment we are setting a baseline for how much genetic variation there is, and then we will look at the environment and management conditions.

“We can then start to answer questions about whether some shapes and architectures of roots are better in say sandy soil, or dry soil, or compacted soil, or soil with different nutrient availability, which then is ultimately about which roots provide better productivity in the field.”

The research has already started field work, working closely with SRA researchers, with more to continue over the duration of the project until mid-2018. SRA acknowledges the funding contribution from the Queensland Department of Agriculture and Fisheries towards this research activity.

**Above (left):** The root architecture of the varieties, left to right, of Q242$^{\phi}$, KQ228$^{\phi}$, and SRA1$^{\phi}$.

**Above (right):** An analysis of washed sugarcane roots.

## *Developing techniques for field analysis of roots*

The work on the roots project is being enhanced by Dr Johann Pierre’s award of an Early-Career Researcher project funded by SRA.

SRA invests in professional development opportunities such as these for researchers to develop innovative ideas that enhance their skills and benefit the Australian sugarcane industry.

This ECR project is working to develop a soil test that would allow researchers to determine the root biomass within a soil core, by using DNA analysis.

It involves using technology that has been developed by the South Australian Research and Development Institute (SARDI) for other crops, and applying it to sugarcane.

It will not only provide information on the root biomass in the soil, but also on those roots which are alive and those that are dead.

It could have useful applications in a range of field tests, including disease situations where it is important to understand what is happening underground.

All of this will help provide information about understanding the overall function of the roots, which includes the turnover of roots within sugarcane.

“We know there is a turnover of root systems in other species, and this technique will give us the tools to understand how much root turnover there is within sugarcane, and particularly between ratoons.”

**More information**

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