NEW TECHNOLOGY COULD MEAN A LEAP FORWARD IN ON-FARM DISEASE DETECTION

Every year plant diseases cause huge economic losses to the sugarcane industry. Combating them, however, is no easy task. While the key to management of diseases is their early diagnosis, in some cases methods currently in use haven't been upgraded for over a decade. Hardly any of these methods are useful for rapid on-farm disease detection in a cost-effective way.

SRA's Principal Research Scientist Dr Shamsul Bhuiyan is working with experts from Griffith University to address these challenges.

"The aim of this work is to use recent advances in nanotechnology for development of disease diagnostic devices for human diseases, and apply them to the sugar industry," Dr Bhuiyan said.

Dr Muhammad J. A. Shiddiky, the Griffith expert leading this project, said that the methods currently used for diagnosis of various sugarcane diseases rely on sophisticated instrumentation located in centralised laboratories far away from farms.

It usually takes several days for the samples to travel to laboratories and the results to be communicated back to farmers. The delays may hamper timely adoption of steps on farm to manage the disease.

"What we are trying to achieve here is to develop a simple to operate portable disease sensing device which can be packed in a small box and transported to farms," he said.

"So instead of samples traveling to the laboratory, we want to develop a system where the laboratory travels to samples, without compromising on the sensitivity of the device or involving high costs.

"Our proposed device may be cheaper or comparable to the current methods."

Using leaf scald disease (LSD) as a model, Dr Bhuiyan and Griffith researchers Ms Nahian Binte Aziz, Dr Muhammad Umer and Dr Muhammad JA Shiddiky have recently developed a method which can provide both colorimetric and electrochemical capabilities for detection of LSD causing bacteria.

Reagents when mixed with the sample change colour from colourless to blue if the target organism (i.e. LSD-causing bacteria) is present and the intensity of blue colour gives a somewhat arbitrary indication of level of bacteria in the sample (severity of disease).

"This colorimetric test is easy to use and could be performed by farmers. Such a test will be useful for first-pass rapid screening," Dr Bhuiyan said.

The test is essentially based on detection of specific DNA sequences of LSD causing bacteria and uses sugarcane xylem sap or small punched-out pieces of leaves as starting sample materials. Researchers have used a simple boiling-based DNA extraction method to streamline their downstream colorimetric and electrochemical detection.

The pivotal component of this project however is the use of novel nanomaterials which are highly stable in routine weather conditions and their cost of production is also very low.

In addition to the colorimetric screening, the same sample can be used for further sensitive electrochemical quantification. Although electrochemical testing requires skilled personnel, the instrument is still portable and can be easily carried in a laptop sized bag.

Dr Shiddiky said that the whole process takes less than two hours and can be easily modified to test several samples in parallel or to test for two or more diseases simultaneously.

The team has so far been able to successfully test their method in a range of samples collected from SRA experiments.

"We tested both susceptible and resistant varieties at SRA Woodford Pathology Station and were able to accurately match the susceptibility or resistibility of any particular sugarcane variety based on bacterial DNA levels," Dr Bhuiyan said.

"So far, our detection limit is a few hundred to a thousand bacterial cells. Building upon these proof-of-concept results, the team aims to further expand this work to other important sugarcane infectious diseases.

"We are aiming to develop a device which can rapidly detect multiple sugarcane diseases in a large number of samples in a short span of time and without extensive sample processing. Our ultimate aim is to develop a platform whereby farmers can rapidly screen their crops for any suspected infections. If needed, further sensitive quantification can then be provided by trained staff," Dr Shiddiky said. ■

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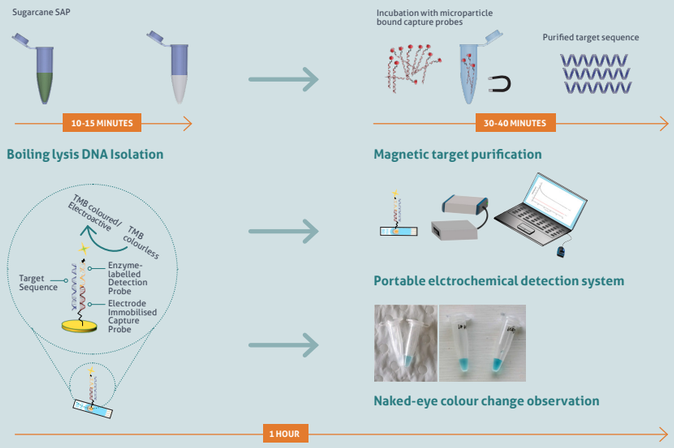
KEY FEATURES OF THE ASSAY:

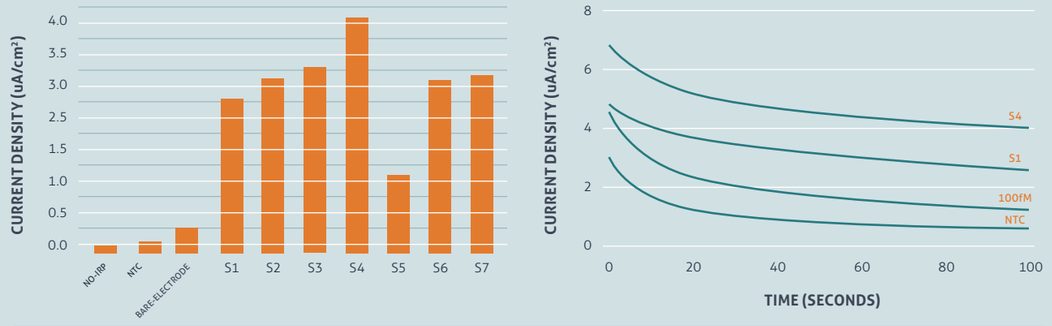
- **INTEGRATION OF SIMPLE AND RAPID DNA ISOLATION**
- **PORTABLE SYSTEM FOR ON-SITE APPLICATION FOR DISEASE DETECTION**
- **COLORIMETRIC AND ELECTROCHEMICAL DETECTION OF SUGARCANE DISEASES**

(Over page) Detection of leaf scald 'colour change', Griffith University Researchers Ms Aziz and Dr Umer.
***(Above)** Sample collection from leaf scald infected sugarcane from SRA Woodford Pathology Station Dr Shiddiky (Griffith Uni) and Dr Bhuiyan (SRA).*

***X.albi.* Detection in Field Samples**



***X.albi.* Detection in Field Samples**



- *The assay successfully detected* X. albi. *in sap collected from field sugarcane samples*
- *Our results matched with the field susceptibility data (operator blind experiment)*
- ***(Fig. 2)** Density bar and chronoamperogram for plant xylem saps collected from SRA Woodford leaf scald screening trials. Samples were collected and supplied to the Griffith University laboratory labelled with random numbers (S1 to S7). Note: sample S5 was highly resistant variety showing lowest current density, NTC=no target control, Bare electrode = no electrode immobilised capture probe.*