CRC Sugar Industry Innovation through Biotechnology

project profile

genetic engineering and sugarcane — health, consumers, farms and the environment

an update from the Cooperative Research Centre for Sugar Industry Innovation through Biotechnology(CRC SIIB)

Genetic engineering is giving sugarcane a chance to prove its versatility and potential as a health product, as a replacement in the fossil fuel-to-product chain, on farms and in the environment.

Human health

Sugarcane molasses has potential to fight Type 2 Diabetes

In healthy people, the carbohydrates we eat are broken down to sugar in the blood to give us energy. Enzymes like alpha-glucosidase in the intestine help this happen.

Our blood sugar is regulated by insulin. However, for a person with diabetes type 2 or non insulin-dependent diabetes, this regulation doesn't work well. A type 2 diabetic typically has high blood sugar levels, poor insulin secretion and insulin resistance.

Researchers have found that a special molasses extract stops the alpha-glucosidase enzyme from working efficiently. If this extract eventually proves effective in reducing blood sugar levels in Type 2 diabetics, it could slow or even stop the onset of insulin-dependent diabetes and its associated health risks.

Consumers

From sugarcane to plastics, drugs and solvents

An Escherichia coli (E-coli) that grows very quickly on sugar is being developed to help produce plastics, pharmaceuticals, solvents, detergents, fibres and food products. Currently, these products are mostly produced from fossil fuels.

Through fermentation, sugarcane can replace crude oil, natural gas and coal as raw material. Sugarcane is the preferred plant to use because it is highly water, energy and land-use efficient and because crop residues are collected and can be used to supply the processing energy.

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Over the next generation, the global chemical industry (nearly US$2 trillion) will shift from being petrochemical-based to being biomass-based, driven by high petrochemical and environmental compliance costs.

On farms & in the environment

Sugarcane that uses nitrogen efficiently

New research is uncovering just how the sugarcane plant uses nitrogen (N) fertiliser to make protein and grow. The aim is to find the genes responsible. Genes that provided protein efficiently would be used in a conventional breeding program with existing varieties to produce a nitrogen-efficient plant. The new plant would use less N to make the same amount of sugar. Potential benefits for growers include lower N-fertiliser inputs and costs and less N run-off to rivers and streams.

When too much is not enough

Don't add too much inorganic nitrogen fertiliser – it's not the only source of nutrients for sugarcane! According to recent research, the crop uses and even prefers some forms of organic nitrogen. This means that the organic N from trash and other sources such as legumes in rotation should be considered in the N budget of sugarcane farming, since they provide nitrogen in forms available for the plant. Measuring the amount of organic N needed for best cane growth could pave the way for fewer and lower applications of inorganic fertiliser.

Regulation and release of GM crops for the future

Sugarcane usually reproduces vegetatively - but that is not always the case. It can also reproduce from seed. Researchers are trying to find out whether, if a genetically modified (GM) sugarcane variety is planted next to non-GM crops or wild sugarcane, it will accidentally pollinate them or introduce its genes through a stray vegetative bud.

The job of assessing the likelihood of GM plants spreading and possible impacts on human health falls to the government regulator, the Office of the Gene Technology Regulator. OGTR decides whether or not to introduce a GM variety.

To supply part of the data needed by OGTR, researchers are working out what conditions lead to germination and establishment of sugarcane plants.

They have found that sugarcane seed germinates best at 36°C in the laboratory. However, in sugarcane growing areas, temperatures are lower, so germination is also lower. Researchers expect germinating conditions to be poorer again in sugarcane fields because there, the seeds dry out, are eaten or if they do germinate, have to compete with other plants suggesting that successful spread of GM seed is unlikely.

While more research is underway, results to date have been discussed with the OGTR and contribute to the pool of information they are using to ensure the safe release of approved plants for field trials.

Getting sweeter

Research into why some sugarcane plants are better sugar producers than others is uncovering the role sugar transport and storage plays. The eventual aim is to increase the sugar production efficiency of all cane varieties.

Researchers questioned why some sugarcane plants are better sugar producers than others and hypothesised that they transport and store sugar better. To check this, they isolated the genes responsible for transporting and storing sugar in different varieties to see if differences do exist. Early findings suggest they do and now researchers are homing in on just how these genes affect sugar accumulation.

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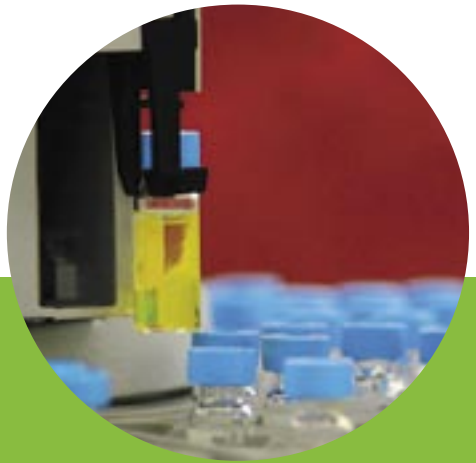

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