

QUESTIONS AND ANSWERS ON DIR 051/2004 - GM SUGARCANE LINES EXPRESSING SUCROSE ISOMERASE

1. What is sugarcane?

Sugarcane is an established agricultural food crop with a long history of safe use. It has been cultivated in Australia for more than 100 years.

In Australia sugarcane is commercially cultivated over a 2100 km stretch on the east coast from northern New South Wales (approximately 30°S) to northern Queensland (approximately 17°S) with the actual planting area distributed unevenly across this range. A small industry also exists in the Ord district in Western Australia. About 98% of Australian sugar exports originate in the Queensland coastal region.

In commercial production, sugarcane is propagated vegetatively from stem cuttings. Seed is only produced for breeding purposes. Germination from cuttings (setts) occurs within 2-3 weeks. Hot and wet conditions in summer months (January- March) encourage rapid crop growth. Subsequent cool and dry conditions in winter (August-November) allow ripening. Harvesting occurs prior to flowering in order to maximise the sugar content of the canes.

Sugarcane harvesting in Australia is fully mechanised. Prior to harvest, the crop may be burnt to destroy trash. After harvest, the fields with remaining stubble are cultivated, fertilised and allowed to ratoon (regrows from underground buds). Current practice in sugarcane cultivation is to grow two ratoon crops subsequent to the initial planting over a 3-4 year period.

Further detailed information on sugarcane can be found in a review document 'The Biology and Ecology of Sugarcane (*Saccharum* spp. L. hybrids) in Australia' which is available at www.ogtr.gov.au or via Freecall 1800 181 030.

2. What is sugarcane used for?

Sugarcane is primarily grown as a source of sugar (sucrose). Sugar is initially extracted from the raw cane at sugar mills distributed throughout the growing region. The cane is shredded and the juice extracted by crushing. The juice is then processed into sucrose. Neither DNA, nor protein is present in the refined sugar.

Several by-products of sugarcane are also produced from crushing sugarcane. These primarily include bagasse and molasses. Both by-products are mainly used as animal feed.

3. How have the GM sugarcane plants been modified?

The GM sugarcane plants have been modified to express the sucrose isomerase gene (*si*) gene and the neomycin phosphotransferase gene (*nptII*). The particle bombardment method was used to 'shoot' the genes into sugarcane cells in tissue culture in the laboratory. These cells were then regenerated to form individual whole plants, referred to as lines. Multiple plants of the same GM line are produced from stem cuttings for testing. Each GM sugarcane line may contain multiple copies of the genes, inserted at different locations in the sugarcane genome.

The *si* gene produces the enzyme sucrose isomerase (SI), which converts sucrose produced in the GM sugarcane plants into isomaltulose. The *si* gene was isolated from the bacterium *Pantoea dispersa* (isolate UQ68J).

The GM sugarcane plants also contain the *nptII* gene, derived from the common soil bacterium *Escherichia coli*, which confers resistance to aminoglycoside antibiotics such as neomycin and kanamycin and geneticin. None of these antibiotics are used to treat plant diseases, and they are not used routinely for human or animal therapy. Expression of *nptII* gene was used to select transgenic plants in the laboratory and it will have no role in the proposed field trials.

The GM sugarcane also contains another antibiotic resistance gene from *E. coli*, the beta lactamase (*bla*) gene. However, this gene is not expressed as it is controlled by its bacterial promoter which does not function in plants

4 What is isomaltulose?

Isomaltulose is an isomer of sucrose, produced naturally by some microbes. (An isomer is a molecule with the same kind and number of atoms but in a different arrangement.) Non-GM sugarcane does not produce isomaltulose.

Isomaltulose can be used in food as a sucrose substitute and it has been used in Japan since 1985. Isomaltulose is known to be an acariogenic sweetener (i.e. it does not support the growth of oral bacteria which can lead to tooth decay). It is digested more slowly than sucrose and thus has health benefits for diabetics and non-diabetics.

Currently, isomaltulose is produced industrially from sucrose, using bacteria that naturally produce the SI enzyme. The cost of producing isomaltulose in sugarcane is expected to be much lower than the current industrial processes.

5 What are these proposed trials for?

The main aim of the proposed trials is to evaluate the agronomic performance of GM sugarcane plants containing the *si* gene under field conditions. The GM sugarcane lines covered by this application are still in the early stage of research and development. The release would be limited, covering maximum total area of 3.55 ha/year at CSR sugarcane research station in Burdekin Shire, and controls are proposed to limit the spread and persistence of the GMO and the introduced genetic material.

The GMOs will be planted by hand. The planting materials will be either stem cuttings or seedlings. Following cultivation, mature stems will be harvested prior to flowering for agronomic evaluation. After harvesting, underground buds will be allowed to regrow as ratoon crops for further testing.

None of the GM sugarcane plants from the proposed release, or their products will be used for human food or animal feed. All material from the GMOs not required for future plantings or research will be destroyed. Food use of this GMO and its products would require Food Standards Australia and New Zealand (FSANZ) approval.