

## Genetically Modified Sugarcane: A Case for Alternate Products

**Janet Grice, M.K. Wegener, L.M. Romanach,  
and S. Paton**

*The University of Queensland*

**P. Bonaventura and S. Garrad**

*BSES Limited*

Current community attitudes towards genetically modified (GM) plants are quite negative, with the sugar industry having apparently accepted the view that sugar from genetically modified cane is regarded so badly by consumers at the present time that it could not be marketed successfully. In other industries, genetically modified cultivars that are environmentally friendly and not designed for human consumption (e.g., Bt cotton) have been accepted reasonably well. One of the main causes of public concern about genetic engineering has been the lack of information about the process and the types of products, particularly nonfood products, that can be developed. This paper describes exploratory research in the sugar industry in Queensland that attempted to determine the effect of providing information on gene technology on the attitudes of cane growers, their partners, and community members and the types of genetic modification that was most acceptable to them. Attitudes to genetic engineering of sugarcane, in general, were judged to become more positive, and the real concerns over introduction of the technology were revealed. Those applications that were most acceptable were also identified.

**Key words:** biotechnology, consumer attitudes, focus groups, genetic engineering, transgenic cane.

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### Introduction

The Australian sugar industry has been suffering from low world sugar prices over the past decade, increasingly competitive world markets for sugar, and the recent strengthening of the Australian dollar. Keating, Antony, Brennan, and Wegener (2002) suggested that the industry will need to diversify into other forms of value-added products to regain former levels of profitability, since productivity gains of the order of 2–3% per year are needed just to meet the cost-price squeeze faced by Australian farmers. Although existing lines of research made sugarcane production more efficient, a step up to new levels of profitability is needed in the industry—and that will depend on creating and applying new knowledge. Due to the potential for new alternative uses for cane, such as supplying high-value niche markets with a variety of products, Hildebrand (2002) also emphasized the need for further analyses into product diversification as a way of increasing industry returns.

A new Cooperative Research Center (CRC for Sugar Industry Innovation through Biotechnology) was created in July 2003. This collaborative research joint venture seeks to make sugarcane production more profitable through cane improvement and industry diversification through the application of biotechnology.

Such new approaches to plant improvement might enable the cane plant to store higher levels of sucrose or

to produce and store new products with wider markets than sugar. Potential improvements include higher production levels (through higher sucrose content and longer harvest seasons) with some potential for reduced environmental impact, possibly achieved by developing varieties that use water and nitrogen more efficiently, by decreasing the dependence on applied chemicals to control pests and diseases, and by the creation of a renewable source of biodegradable end products (potentially including bioplastics and pharmaceuticals). As Keating et al. (2002) pointed out, the advantage from such new knowledge will go to those who can use it first. The successful development and utilization of transgenic canes (with new genes incorporated by genetic engineering) could therefore have a key role to play in the survival of the Australian sugar industry.

The benefits from these developments could spread across the industry from research institutes—including BSES Limited (formerly Bureau of Sugar Experiment Stations) and its collaborators, who are involved in developing canes with new attributes—to other industry stakeholders and eventually to consumers. These new canes would embody protected intellectual property; industry partners would benefit commercially from having access to raw materials from a renewable source to be used in consumer products. Consumers would also

benefit by being able to use products that have less impact on the environment.

Public opinion currently appears to be biased against foods derived from genetically modified (GM) organisms. As a result, the sugar industry apparently accepts the view that sugar from genetically modified cane could not be marketed successfully at the present time. On the other hand, genetically modified cultivars that are environmentally friendly and not designed for human consumption, such as Bt cotton (i.e., cotton cultivars with the genes from the bacteria *Bacillus thuringiensis* inserted by genetic engineering processes), have been accepted reasonably well in Australia.

One of the main causes of public concern about genetic engineering has been the lack of knowledge about the process (Norton, 1999). Lack of transparency in introducing genetically modified crops (and resultant foods) has increased consumers' wariness of these new products. Without consumer acceptance, the development of transgenic canes would appear to be superfluous. Therefore, the sugar industry needs a proper assessment of the potential benefits and risks that could flow from the introduction of transgenic canes for the production of alternative products to sucrose.

### Consumers' Attitudes Towards Genetically Modified Products

Consumer concerns towards the products of genetically modified organisms can be expected to affect consumption decisions, which in turn can have significant impact on the demand for these products throughout the food system (Giannakas & Fulton, 2002). For that reason, various studies have been assessing the consumer acceptance of genetically modified products.

Perhaps the best-known research instrument used to assess consumer knowledge about genetic engineering is the Eurobarometer, a survey of consumer attitudes conducted biannually throughout Europe since 1973. A section on opinions about modern biotechnology is carried out at two- to three-year intervals. In the 1991 survey, levels of support for biotechnology differed according to application, with research into microorganisms receiving more support than plant research, food research, and research involving farm animals. Regardless of application, there was strong support for government control of genetic engineering (INRA, 1991). In 1996, the results showed that although the public's knowledge of biology had increased, people were less optimistic that applications of biotechnology would improve living conditions. There was strong support for

labeling of products and of the need for public consultation (Wagner et al., 1997). The 2002 survey showed, again, that a majority of Europeans do not support genetically modified foods. There was, however, an increase in support for biotechnology compared to the 1999 survey (Gaskell, Allum, & Stares, 2003).

It has been argued that because consumers do not have knowledge of current biological practices, they are being unduly suspicious of new scientific advances. According to some prominent geneticists, suitable education will dispel the public's "irrational" fears (Peacock, 1994). Indeed, Kelley (1995) considered that acceptance would increase as people became more aware of genetic engineering and its applications. However, overseas research has demonstrated that this is not the case (Wagner et al., 1997).

Scholderer and Frewer (2003) argued that a general conclusion to be drawn was that compared to other applications of gene technology, genetically modified foods were seen as unacceptable, because they lacked tangible consumer benefits. Hossain, Onyango, Schilling, Hallman, and Adelaja (2003) also share this view, arguing that "unless biotechnology is able to bring tangible benefits it will be very hard, if not impossible, to persuade consumers to accept GM food products whose safety [is] still a matter of concern to many" (p. 354). The authors of this study undertook further study in the United States to assess how public acceptance of genetically modified fruits and vegetables was related to the consumers' socioeconomic and value attributes. The results of this study showed that only half of the survey respondents approved of this technology when it does not bring any benefit to consumers. However, about three quarters of Americans approved of the use of biotechnology in food production to bring specific and direct benefits to consumers. The Hossain et al. (2003) survey also pointed out that there is considerable divergence of views among consumers about GM food products, with male, middle-age consumers more supportive of GM foods than older males (55 years or older) and female respondents.

Norton, Lawrence, and Wood (1998) reported that acceptance of a product varied according to the type of gene transfer involved, the perceived benefits of the product, and whether the resultant product was to be ingested. Path analysis of the data gave some indication of what affected people's acceptance of genetic engineering. Knowledge had no direct influence on acceptance. People who supported science and technology and who trusted government and industry were more accepting of the technology. Those who had concerns

about current food technologies were less accepting. The sex of a person had the greatest effect on acceptance, with women being less accepting than men. It can only be hypothesized why such an effect should exist, but it would appear reasonable to assume that this is related to the fact that women are the childbearers (and still often the child rearers) and thus are more concerned about the potential future effects of genetic engineering. Within qualitative data gathered in the survey, concerns for the future and future generations were repeatedly reported as a reason for not being fully supportive of genetic engineering (Norton, 1999).

Focus group research conducted in Australia in 2002 considered the interpretation of risks associated with GM foods by consumers. Participants in this study did not reject the technology but rather demonstrated their need to know that the technology was being properly regulated. Their perceptions of the technology were, however, constrained by the lack of information—both for and against—that was available to them. When industry and science do not provide them with adequate information relevant to both sides of the debate, the public will obtain information from other sources—usually media. Participants were anxious to see the development of explanatory material by sources trusted by the public. This material must contain factual information of both the pros and cons of the technology for the public to be influenced by it (Grice & Lawrence, 2003).

Information is a valuable resource and has a key role to play in forming people's opinions towards GM products. Research reported by Huffman (2003) points out that information from different sources has an effect on consumers' demand for GM foods; information from environmental groups reduces consumers' willingness to pay and pushes some consumers out of the market. However, third-party information had a moderating effect against the extreme views of both the agricultural biotechnology industry and environmental groups, dissipating virtually all resistance to GM foods caused by the environmental groups' perspective. This study also showed that participants who claimed to be informed about GM technology in the pre-experiment survey were unlikely to be in the market for GM food products, suggesting that prior information about GM foods was primarily negative.

### **The Research Project**

The research that conducted was qualitative in nature, using a series of focus groups and workshops. With the assistance of BSES staff in Bundaberg and Innisfail,

cane-growing couples were recruited to the project. These couples had to meet certain selection criteria (e.g., having cane growing as their primary income source and considering they had a future in the industry). Where possible, a spread of ages was sought among the couples as well as a mix of industry leaders and general growers. Recruited couples were required to participate in an initial focus group meeting where growers and their partners were divided into separate groups (for male and female participants). Focus groups that involved local community representatives not connected with the sugar industries were also conducted.

The focus group discussions were designed to explore participants' knowledge of genetic engineering and to determine the type of information participants thought they needed in order to make sensible choices about whether the sugar industry should adopt or reject the technology of genetically engineered sugarcane varieties. The type of product that was most acceptable to the participants was also investigated. In particular, the acceptability of cane genetically modified to produce plastic was examined.

Based on the focus group discussions and previous research, a workshop was developed and held in each area. The workshops presented information on gene manipulation techniques, regulation of gene technology, current controversies about genetic engineering (e.g., the effect on monarch butterflies), and consumer attitudes to genetically engineered foods. In addition, some of the reasons for engaging in the technology were addressed. The topics presented at the workshops were chosen as a result of the initial focus group discussions. Following the workshop, another set of follow-up focus group discussions was conducted to determine any changes in attitudes. The time from first to final focus group meetings was kept to a minimum to reduce the effect of outside influences on participants' attitudes—limiting the time between initial and final focus groups allows researchers to decide with greater certainty if provision of information has, in fact, changed participants' attitudes. Participation by the growers and their partners remained high throughout the project, but the number of community representatives dropped throughout the process. This was anticipated, as the project required a substantial time commitment from participants, and community members did not have the same commitment to the industry as growers. Participation rates are shown in Table 1.

**Table 1. Attendance at activities.**

Location	Cane growing couples						Community representatives		
	Initial focus group			Workshop			Workshop	Final focus group	
	M	F	M+F	M	F	M+F		M	F
<b>Bundaberg</b>	8	8	16	8	8	9	7	5	
<b>Innisfail</b>	10	9	20	10	10	10	9	6	
<b>Total</b>	18	17	36	18	18	19	16	11	

*M: males; F: females; M+F: males and females.*

## Results

The initial focus groups showed that a number of people had limited knowledge of genetic engineering and its applications. For most, information had been obtained in an ad hoc manner through media reports. This information focused primarily on opposition to the technology and was provided either directly or indirectly by groups such as Greenpeace. Some members of the community groups, however, had actively sought information on gene technology. In particular, a small group of active organic farmers who participated in these activities was extremely vocal in their opposition to the technology and could quote many of the controversies surrounding acceptance of genetic engineering. These participants demonstrated that they would unquestioningly accept the opinion of those opposed to the technology but had no faith in statements made by proponents of the technology. Other participants with an interest in conservation had conducted their own research but did not have the same complete acceptance of what was presented to them. They were still, however, very skeptical of information provided to them by industry and government.

There was no knowledge about the regulation of the technology within any group. There was a perception, particularly among those that had some information about the technology, that new crops were introduced into the environment at a faster rate than those that were produced using conventional breeding methods. The Office of the Gene Technology Regulator in Australia and its attendant responsibilities were unknown to participants.

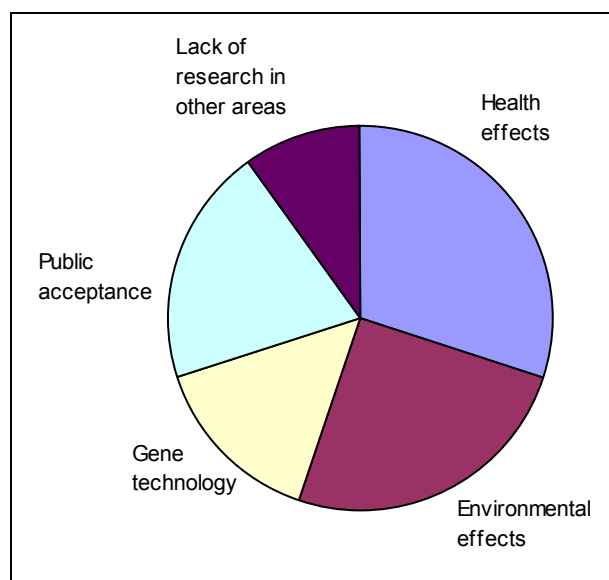
Within the grower groups, men were more knowledgeable than women about the possibilities of genetic engineering in sugarcane. For the men, genetic engineering of sugarcane was seen as the way forward for the sugar industry. They considered that the develop-

ment of new products and more productive canes were vital for the future of the industry. Further probing showed, however, that this attitude was based on the assumption that sufficient testing would have been done prior to release of genetically modified varieties to show that the resultant crop was safe to grow. Male growers perceived genetically modified cane as the next logical step in the sugarcane industry. There were few, if any, concerns about the safety of the crop—either from an environmental or health perspective.

Women had more concerns regarding the safety of the new technology. They were concerned about the effects on health of eating genetically modified foods and the possible reactions from the community to the growing of these crops. This concern was more apparent in Bundaberg than Innisfail, as the growers in Bundaberg increasingly have to interact with the local community. Most participants had few concerns about environmental issues regarding the genetic manipulation of cane. It was recognized that the nature of cane meant that there would be little or no outcrossing of the genes. For the growers, though, there were concerns whether the public would accept a genetically engineered food crop. This was based on suspicion of the media, which they saw as playing a large role in forming public attitudes. They considered that negative aspects of the technology were already being widely reported.

Although women had more concerns than men did, they were often unable to articulate them. This was not because their concerns were not real, but rather they were, to some extent, beyond their own comprehension. The possible health and environmental effects were unknown and largely in the future. This attitude was based on previous experiences with other introduced technologies. A similar situation was observed among the community members. One of the greatest concerns was that the technology would be seen as a “silver bullet” and that research in other areas of agriculture would be severely curtailed or even abandoned to allow research organizations to concentrate on genetic engineering (see Figure 1).

This was not the case amongst those who had conducted research into the technology. As previously noted, most of their information had been obtained from opponents of the technology. Although they could not articulate any problems from genetically modified sugarcane per se, they were able to mention problems such as the decimation of monarch butterflies, the discovery of GE maize in Mexico, and Percy Schmeisser’s court case with Monsanto. They used each of these examples to argue the case against genetic engineering in general



**Figure 1. Relative importance of concerns—first focus group.**

rather than looking at sugarcane as a particular example of the technology. For the more vocal of these participants, the technology had no redeeming features. They were only a small number of the participants but they put their case in a very forceful manner.

The enthusiasm of the workshop presenters and their support for the technology was recognized by the participants and they took that into account when assessing their presentations. Presenters were strongly supportive of gene technology. This was done purposefully, as it was obvious during the initial focus groups that participants had not heard from proponents of the technology. The nature of the research was to assess the effect of information on people's opinions, not to provide them with balanced information. One presenter, however, was requested to speak on current controversies such as the effects of genetic engineering on monarch butterflies. This speaker provided alternate views on the situation.

Between seven and ten days elapsed between the workshops and the final focus groups. This time allowed the effects of the individual presenters to be minimized but was short enough to allow participants to have sufficient recall of the information provided at the workshops. A television program concerning genetic engineering was screened in both Bundaberg and Innisfail in the intervening time. Although participants commented on the program, it appeared to have no effect on attitudes and perceptions presented in the final focus groups.

In the final focus groups, male growers were still very positive about the use of gene technology in cane. They did not question the safety of sugar from GM cane when eaten, as they did not consider the final product would contain any DNA. For them, any questions regarding the technology were seen to be farm management issues. They were also concerned about who owned the resultant new varieties and whether they, as growers, would receive any monetary benefit. Concerns were also voiced about the length of time required to develop new crops based on the technology and that the technology would quickly leak overseas. Although some growers wanted new varieties that were more productive, others argued that better farming practices could achieve greater productivity, and it was more important to develop new varieties that offered new products.

Women growers still voiced some concerns but in general were much reassured by the information supplied in the workshop. One participant commented that she did not realize that all genes were the same no matter what organism they were found in. This was an important piece of information that others also commented on. There were still some concerns over long-term health effects, but this was more in the background rather than a prominent thought. The effects of the media and the need to convince consumers—both in Australia and overseas—were also prominent in the discussions. They considered that it would be necessary to educate the public about the realities of gene technology. For some, the reduced use of “poisons” on crops was seen as a positive step and something that would sway public opinion. The introduction of new varieties that would offer new products that would not be eaten was seen as a positive for the sugar industry.

Concerns were also voiced over intellectual property rights and whether the new varieties would in fact assist growers or drag them into more debt. Many of the environmental concerns had been allayed, particularly in relation to sugarcane. For the community groups, there were slight differences. For some community members, some of their concerns had been allayed. There were fewer references in the final group discussions to detrimental environmental effects and health effects.

Community members were not entirely convinced but were willing to consider the technology in a more favorable manner. However, there were still participants who expressed reluctance to eat the resulting foods; for some, this was a manifestation of their reluctance to try new technologies in general. One participant even expressed reluctance to use a microwave oven in food

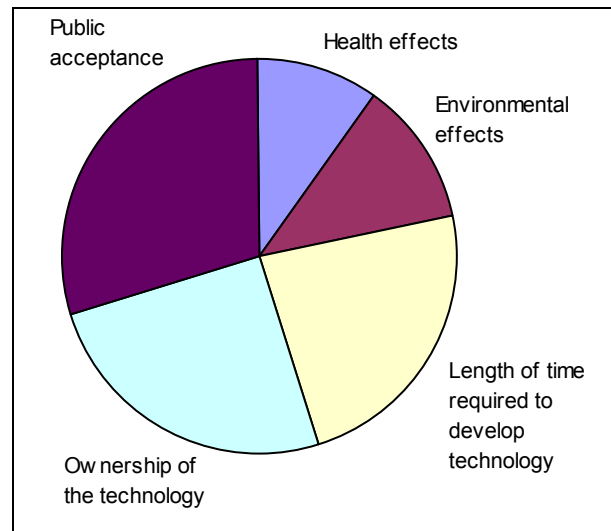
preparation. The concern that we would not know the real effects for several more years was also frequently expressed. Again, questions regarding who owned the technology and who would thus profit from it were raised. The question of whether the general public would accept the technology was also of concern. Overall, community members accepted the introduction of new varieties that would produce products that would not be eaten (see Figure 2).

All the participants who attended the final focus groups agreed that research into the technology should continue and that cane varieties that reduced farming inputs (such as pesticides), as well as varieties that would provide new products (such as bioplastics), should be developed. Even those participants with strong environmental views agreed that new genetically engineered sugarcanes that required less fertilizers and pesticides would benefit the environment. All participants were reassured by the regulatory system that has been put in place in Australia and felt that it would minimize any harmful effects of the technology.

In general, the provision of information about gene technology produced a more positive view of the technology. For those who had already formed the opinion that the technology would enhance agriculture, the information that was provided reinforced their views. For those who had been "sitting on the fence," the information influenced them to adopt a more positive frame of mind. While not totally accepting what they were told, they were prepared to look at it more favorably and reserve their decision until more information and evidence of safety was provided. For those who had already formed the opinion that the technology was harmful, the provision of information appeared to make little difference. However, further probing elicited the information that there were applications of the technology that could be seen to have positive environmental benefits and were thus preferable to some current intensive agricultural practices.

## Conclusion

The project described here was a small exploratory study using qualitative methods to assess attitudes among sugar industry participants and community members to genetic engineering in sugarcane. As such, it is difficult to extrapolate the data to larger populations. The results, however, are consistent with previous studies. It does provide some insights into the way in which genetically engineered cane—particularly if used to produce a product other than sucrose—will be viewed



**Figure 2. Relative importance of concerns following workshop.**

by the community and point to ways in which that attitude might be changed. The provision of information regarding the science behind and regulation of genetic engineering activities caused many of the participants to look at the technology much more favorably and accept genetic engineering of cane. Participants in the study expressed the view that cane varieties that reduced inputs and increased output should be developed. Varieties that could be used to produce other products (such as bioplastics) should also be developed. The latter were seen as the more important area of research. The study also showed that it is not the technology per se that is the cause of concerns being expressed over its adoption. Rather, peripheral issues regarding ownership of the technology, the effect of the media and other pressure groups on the public's acceptance of new products (including food), and the length of time required to produce new varieties still cause many concerns. The effect on the economic fate of growers from using the new technology is also a concern. Until issues such as these are addressed to the satisfaction of both growers and the general public, there will be resistance to the introduction of genetically engineered sugarcane.

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