

ADVANCES IN TECHNOLOGY AND ENVIRONMENTAL AWARENESS IN THE AUSTRALIAN SUGAR INDUSTRY

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I am very pleased to have been invited by Tim Murray, the President of the South African Sugar Technologists' Association, to be the keynote speaker for this year's SASTA Congress. I am particularly pleased to have been invited this year because BSES is celebrating its centenary and, in September 2001, Australia will be hosting the 'new look' 24th Congress of the International Society of Sugar Cane Technologists in Brisbane. Later, I will outline what is on offer at the 24th ISSCT Congress.

I also note that the South African Sugar Experiment Station celebrates its 75th anniversary this year and I congratulate the board and staff, past and present, on their achievements.

I would also like to place on record my appreciation of the excellent working relationship between BSES and SASEX over many, many years - I am sure this will continue into the future.

The Australian sugar industry is heavily exposed to the world sugar price because it exports some 90% of its annual production of about 5 million tonnes of sugar. Consequently, the build-up of the world sugar surplus and the recent decline in world sugar price has caused considerable concern in my industry.

The Australian industry sees itself as a reliable supplier of high quality raw sugar and, through efficiencies, can supply raw sugar as cheaply as most of its competitors. However, the low world price, the emergence of Brazilian crystal, and the economic drivers which have enabled Brazil to compete in new markets have created new dimensions, directions and tensions within our industry.

Moreover, the rise and rise in environmental issues and urban encroachment have also provided some opportunities and pressures for the industry to respond to.

These recent events have emphasised the importance to the industry of focussing on improvements in productivity (we refer to this as vertical expansion) and efficiency, reducing costs, and seeking ways to improve the return on capital costs (labour, land, plant and equipment).

To address these matters, the industry is reassessing production techniques and systems. Growers now place greater emphasis on a systems approach and seeking 'best practices' which will provide sustainable solutions.

One farming system being tested by a BSES team led by Dr Terry Bull is referred to as high density planting, which broadly involves two planting arrangements known as dual row and close row, respectively.

The dual row system consists of pairs of rows 0.5 metre apart with 1.8 metres between centres and, in the close row system, the rows are evenly spaced 0.5 metre apart.

Computer simulations and trial results indicate increased cane and sugar yields of about 20% for dual and 50% for close row systems. The close row system is a step change in technology.

It is clear that high density planting systems are efficient in resource utilisation; for example, less sunlight is wasted, and there is better utilisation of available nutrients and water; and these valuable resources are less available to support weed growth, thus less weed control costs are incurred.

Simple gross margin analyses based on grower costs and expected returns show that close rows will return an increase in profit of about \$A1 000 per hectare per year and will reduce costs of cane production by about \$A5 per tonne. A yield gain of only 5-10 tonnes cane per hectare over the full crop cycle will compensate for the additional costs.

Realisation of the potential from high density planting farming systems involves additional costs. The change to the dual system can be managed with relatively minor modifications to existing equipment, but careful attention to both crop management and harvesting operations is essential to gain these benefits.

However, grower adoption of close rows is constrained by the need to modify their farming system and access to suitable planting and harvesting equipment. 'First best bet' prototype planting and harvesting equipment has been developed by the BSES agricultural engineering section.

Further work is required to assess the adaptability of the close row system across all environments. One of the outcomes of our high density planting work is the need to adopt more precise production techniques, and the outputs from this work are already benefitting the current cane growing system.

At this stage, precision farming is mainly in the minds and hands of the researchers, but there is an increasing awareness by industry of the benefits that it could bring.

Greater attention to planting, growing and harvesting the crop will bring significant benefits. For example, to achieve best crop establishment, more attention needs to be given to growing the cane to be used for planting material and the way it is subsequently handled during planting operations.

Billet planting systems offer significant opportunities to improve efficiencies through less labour and higher work output. However, the current arrangements are plagued by poor germination and the resultant excessive use of planting material.

Our team has shown that the best quality planting material is achieved when the feed rollers of the harvesters used to cut planting material are rubber-coated and adjusted to constant speed.

The agricultural engineers are now turning their attention to improving the precision of the metering mechanism for seedcane from billet planters to capitalise on the achievements in improved planting material.

The concept of double disc openers for planters, taken from the grain industry, has the potential to aid in the development of a precision planter.

Precision agriculture provides the tools for growers to understand the relationship between inputs and outputs. For example, the yield monitor and global positioning system (GPS) installed on a harvester enables a yield map to be produced. These maps provide much more detailed information about crop performance so that the grower can put extra effort or inputs into specific parts of the field in order to improve crop performance. The yield mapping system was developed by the University of Southern Queensland and the National Centre for Engineering in Agriculture, and should be commercially available in the near future.

Yield mapping linked to developments in near infra-red (NIR) spectroscopy on-line on prepared cane in the sugar mill could monitor certain plant nutrient levels in cane. Using this technology may improve crop yields, reduce fertiliser costs and, in some cases, improve cane and sugar quality.

Advances have been made in plant or variety improvement through control of flowering for breeding purposes, family selection and application of near infra-red spectroscopy.

South Africa has long used controlled flowering in its breeding programme, while in Australia this has only occurred since the mid-1980s. Our work was constrained until it was discovered that high air temperatures were inhibiting flowering. Armed with this knowledge, we are now able to make crosses in a tropical environment using previously unexploited germplasm.

The introduction of family selection procedures in the early stages of the selection programme has greatly increased the efficiency of our selection programme.

Application of NIR in the laboratory analyses in the selection programme provides the opportunity to obtain more information about varieties.

In Australia, there is a growing debate about the benefits or otherwise of biotechnology. Unfortunately, much of the debate has focussed on perceived negative aspects of genetically modified foods and has not fully appreciated that biotechnology includes other activities. For example, much has been achieved in pharmaceuticals and diagnostics for plants and animals. In the sugar industry, the development of diagnostic systems has been a significant benefit in quarantine and disease management.

I am hopeful that some balance will be restored to the debate on biotechnology now that the human genome project has been completed. We are similarly hopeful that the application of genetic marker technology will improve the efficiency of breeding programs and provide a better understanding of the interaction between plants and biotic and abiotic factors.

At BSES, we have developed an efficient plant transformation system and this has enabled us to incorporate genes for resistance to Fiji disease, mosaic, and white canegrubs. However, their application in the field is a way off.

Integrated pest management (IPM) is recognised as the way forward in crop protection and managing the pests of sugarcane in Australia. For growers to adopt IPM, they need to understand and believe in it.

In the past, the industry has sought the 'magic bullet', or one-shot solution. Often it is difficult to convince the industry that the 'magic bullet' is still the way. However, the unavailability of pesticides, either for cost or environmental reasons, is bringing home to the industry that we must explore a 'whole system' approach.

For our major pest, the white canegrubs, we have developed IPM strategies. They include the recent development of the soil fungus, *Metarhizium anisopliae*, as a granule for biological control of canegrubs.

For disease, the development of diagnostic procedures is pivotal to better managing them. For a number of years, we have used a serological technique to detect the presence of ratoon stunting disease, and this has given greater confidence in managing the disease.

Australia is a world leader in mechanised harvesting and efficient transport of cane from the field to the mill, and this has contributed substantially to the international competitiveness of the industry.

Increasing crop size, green cane harvesting and the trend to rationalisation has put considerable pressure on the harvesting sector of the industry. In response, harvester power and pour rates have increased significantly, resulting in reduced cleaning efficiency, increased levels of soil and extraneous matter in the cane supply, and inflated cane loss.

Green cane harvesting now exceeds 60% across the industry, but universal adoption is being hampered to a significant extent by the inability of harvesters to efficiently handle heavy, lodged crops. However, increased emphasis on sugar quality is promoting discussion of cane quality and gradually leading to changed practices and procedures which will, over time, reduce the cost of harvest and transport.

Harvesting is still the area of highest cost associated with sugarcane production, such that R&D is focussed on aspects of harvesting and transport to improve performance and reduce costs.

Research has shown that it is possible to improve the evenness of feed into harvesters, and this has been simply achieved by modifying harvester fronts. All available data indicate that pour rate is the most significant harvester variable impacting on final product quality and that the fan speed of the primary extractor primarily impacts on cane loss.

Linkages between machine traffic, soil conditions and productivity have shown that to minimise the effect of traffic on yields, it is important to match crop row spacing with equipment track widths.

The development of the near infra-red cane analysis system by BSES and Sugar North Ltd provides on-line real time analysis of prepared cane in the sugar mill. The system gives outputs of real value to canegrowers for agronomy and harvester performance control, for cane payment, and to millers on factory process control. The results will be that growers can take corrective action if their harvested cane does not meet their standards.

This will come from fibre, commercial cane sugar and, in the future, extraneous matter and soil levels. Feedback on the nutritional status of the crushed cane will help decision-making about fertiliser application for future crops.

From the mill's perspective, better and more timely information fed forward to the process control computer should result in better factory performance.

The advent of very high-powered computers and sophisticated mathematical techniques means that it is now possible to model many of the processes occurring in the factory and optimise their performance. In particular, modelling of the milling process in search of innovative methods is at the forefront of knowledge in this area and emphasis is on increasing capacity of plant and process optimisation.

Overall, the Australian raw sugar industry is ever-increasing the quality of its product and now has on offer a high pol sugar that is superior to Brazilian crystal.

Over the past few years, there has been an increasing impact of environmental issues on the industry. In some cases the industry has been proactive, while in other instances it has responded to issues and this has been driven by government at all levels, international agreements, for example, the Kyoto agreement, the community and by pressure groups. At the same time, environmental issues have provided opportunities for the industry.

The industry has recognised that further economic development cannot be separated from environmental management. Queensland state government legislation has enshrined that caring for the environment is a legal requirement. Keen to avoid the cumbersome legislation that has been imposed on primary producers in Europe, and recognising that the industry is located close to some sensitive ecosystems, Queensland farming groups have advocated self-regulation.

As a result, the Environmental Protection Act 1994 allows for industries to develop codes of practice for endorsement by the Department of Environment. The Code of Practice for Sustainable Cane Growing in Queensland draws together growers' experience and research knowledge to define for cane growers what are 'reasonable and practical measures' to care for the environment in a cane farming system. The code outlines all the elements to consider - nutrition, water, pests, chemical handling, waste management and natural vegetation. The code is a basis for negotiation between industry and government and is a tool for extension advice on sustainable farming systems.

The Queensland government will spend \$A41m over the next four years across the sugar, cotton, dairy and fruit and vegetable industries to:

- Promote the adoption of programmes to improve water use efficiency on farms
- Reduce water losses from farm storages
- Provide financial incentives to achieve best practice irrigation water management
- Reduce water losses in irrigation water supply and distribution systems.

The need for irrigation has been recognised in the sugar industry for over 100 years. About 500 000 hectares of land are currently under production and about 40% of the water used for irrigation in Queensland is used to grow sugarcane. About 60% of our total cane production depends on it. It therefore follows that irrigation water is an important cost of cane production in many districts.

Many of the water resources are fully allocated and the only avenues for industry expansion are to increase the amount of water available or to improve water use efficiency.

It has been recognised that waterlogging reduces cane yield, and improving on-farm irrigation and drainage generally leads to increases in productivity. What the government initiative is trying to achieve is a 'win for all' situation, where irrigation water is applied efficiently for the good of the crop, the grower, the industry and the environment.

Improvements in water use efficiency have been and are continuing to be achieved through land levelling, better irrigation scheduling, efficient water applications, tailwater recycling, changing farm design and so forth. However, the industry has recognised that further improvements can be made in these and other areas. The aim is to have 70% of irrigators in the sugar industry using best management practice by 2003.

Worldwide concerns about greenhouse gas emissions and global warming have focussed governments on ways to meet international and domestic obligations. In Australia, this has provided our industry with opportunities to exploit its natural advantage of a renewable energy source that is located relatively close to the highly populated areas.

Currently, there is a growing interest in a major investment in renewable energy sources and cogeneration of power by the sugar factories. In the past, many sugar factories exported surplus electricity to the power grid. However, in the current environment, premiums are being offered and the benefits of synergy between two industries are attracting power generators to work with the sugar mills to improve efficiencies and maximise the exporting of power. In addition, the agriculture sector is researching opportunities to improve the supply of biomass, including higher fibred varieties and high density planting for cogeneration of power.

Surveys indicate that the sugar industries in Australia and southern Africa are similar in their cost structures, and that Brazil has the edge on both industries in this regard. However, recent times have shown that this situation can change rapidly and that economies of scale and the quality of the product are important.

This is the challenge that the Australian industry faces, and its future will depend on how it can best exploit technology to ensure that it is sustainable, profitable and internationally competitive.