THE 2006 HERBERT MODDUS® PILOT PROGRAM

By

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Abstract

MODDUS® (active ingredient Trinexapac ethyl) is registered for use as a crop growth regulator or crop ripener in numerous South American sugarcane growing regions. Between 2003 and 2005, field trials were undertaken to assess the chemical's potential as a crop ripener for the Australian sugar industry. The results indicated that the chemical has significant potential as a crop ripener to increase commercial cane sugar (CCS) at particular times during the normal harvesting period available for the Australian sugar industry. The product is currently not registered in Australia. However, a permit was granted by the APVMA in early 2006 to undertake the pilot program and to conduct further research. It is hoped that the product will be fully registered for use in the Australian sugar industry soon. It was decided to establish a pilot program in 2006 to assess the commercial opportunities that such a product could deliver to an Australian sugarcane growing region. With support from Syngenta Crop Protection Pty. Ltd., CANEGROWERS-Herbert River, BSES Limited, Herbert Cane Productivity Services Limited (HCPSL), CSR Sugar, Queensland Mechanical Cane Harvesters Association (QMCHA) and SRDC, the 2006 Herbert MODDUS® Pilot Program was established.

Introduction

Crop ripeners are used extensively overseas to increase CCS and as a crop management tool in regions where cane harvesting seasons are considerably longer than most Australian milling situations (Kingston et al., 1991; McDonald et al., 2001).

As part of an SRDC funded project (BSS264 Adoption of an Optimum Season Length for the Herbert) the research team (consisting of BSES Limited, CANEGROWERS - Herbert River, CSR Sugar, HCPSL and QMCHA) investigated the opportunities to use crop ripeners or growth regulators to increase CCS and the possibility of using such products as a crop management tool.
The Herbert River district, which consists of approximately 65,000 hectares under sugarcane production, was selected for the pilot study. The region consists of a diversity of soil types and micro-climates and enabled the chemical to be assessed in a number of different situations.

After discussions with numerous chemical companies it was decided to partner with Syngenta Crop Protection Pty. Ltd. to undertake large scale aerial application trials of MODDUS® during the harvesting seasons of 2004 and 2005 (Di Bella et al., 2004). MODDUS® was selected because it was commercially available in some South American sugarcane growing regions and posed little off-target risk when compared to some other products (Rixon et al., 2007).

The results from the 2004 and 2005 trials were promising and generated considerable interest in the product. Late in 2005, Syngenta Crop Protection Pty Ltd. and the BSS264 research project team established the 2006 Herbert MODDUS® Pilot program. A working team consisting of industry and Syngenta Crop Protection Pty Ltd representatives was established to support the program.

The purpose of the 2006 Herbert MODDUS® Pilot program was to:

- Investigate the product’s commercial worth to the industry.
- Investigate opportunities to use the product throughout the cane harvesting season to increase CCS and sucrose recovery.
- Develop a crop management and application program for the product.
- Gain a better knowledge of crop responses under different environmental conditions.
- Investigate pricing options to manage chemical response and industry risk.
- Develop a chemical handling and accreditation program to support the product.
- Develop environment guidelines for the safe handling and application of the product.

**Methods**

**Seeking participants to be involved in the pilot program.**

Growers were invited to participate in the program through a group extension program operating throughout the district. At group extension program meetings, Syngenta made a number of presentations highlighting the benefits of the product, the issues experienced to date and the way in which the program would operate. Interested growers were asked to register for the 2006 MODDUS® pilot program and attend a MODDUS® accreditation workshop.

**MODDUS® accreditation and ‘Good Neighbour’ program.**

Syngenta Crop Protection Pty. Ltd., with assistance from BSES Limited, developed the MODDUS® accreditation program for growers and aerial applicators interested in participating in the program. The purpose of the accreditation program was to inform growers and aerial applicators of:

- The structure and purpose of the pilot program.
- The safe handling and use of the product.
- Product performance to date and associated crop management issues.
- The payment system and benchmarking process.
- Environmental compliance issues.
The ‘Good Neighbour Program’ whereby growers would notify and inform others in their immediate area that they intended to apply the product and develop management strategies to minimise off-target issues.

In the Herbert region, 72 farming businesses and 2 aerial applicators were accredited. On completion of the accreditation program, growers were asked to sign a written contract with Syngenta Crop Protection Pty Ltd and indicate possible blocks for the pilot program.

Field selection and block recording
Field inspection of every nominated block was undertaken by Syngenta Crop Protection Pty Ltd, BSES Limited and HCPSL staff. The purpose of the field inspection was to:

- Determine if a block was suitable for inclusion, based on crop agronomic guidelines.
- Collect crop agronomy and disease data from each block, which would be used for further analyses.
- Check that variety type was correct.
- Establish grower benchmark and payment benchmark blocks, with treated and untreated replicated areas for comparison purposes.
- Investigate any potential off-target issues (e.g. proximity to houses, schools, public roads and other environmentally sensitive areas).

A number of nominated cane blocks were not included in the pilot program because they did not meet the criteria set down.

With assistance of HCPSL staff, the cane block recording system was altered and all blocks included in the pilot program were allocated an identifying block number and were colour coded differently on maps.

The reason for this activity was to assist with the easy identification of blocks within the program and to assist harvesting crews to consign harvested blocks correctly.

Aerial application
To minimise aerial application costs to the growers involved in the pilot program, it was agreed to apply the product in a coordinated manner.

Early harvested blocks were treated from 10–12 May 2006 and the late harvested blocks were treated on September 20, 2006. A total of 117 early harvested blocks were treated with MODDUS® by helicopter.

The flight logs of the aircraft were captured by GPS and overlayed with the GIS cane block map data to ensure that the correct fields had been treated and to check the accuracy of application.

Harvesting
Trial blocks within the program were harvested by commercial harvesting contractors. The cane in the pilot program was consigned according to specific instructions and block maps provided to all harvesting crews.

A red identifying sticker with the wording ‘MODDUS® TRIAL’ was attached to the consignment note. The purpose of the sticker was to inform train crews, juice lab and other mill staff that the consigned cane was part of the pilot program and that the data should not be compromised in any way.

Payment system and benchmarking
An innovative risk sharing pricing model was designed for the pilot program to allow growers to assess the performance of the product while minimising financial risk. A paper
(Dorahy et al., 2007) presented at this conference explains the payment system. Under this system growers paid a fixed proportion (36%) of the net value of the incremental increase in CCS ($/ha) for using MODDUS®. The incremental increase in CCS was determined by measuring CCS in plots treated with MODDUS® in comparison with untreated plots.

Growers were given the option of leaving untreated strips in their MODDUS® treated fields, or alternatively treating the whole field and referring to the average result from sub-district benchmark fields for payment purposes.

The untreated and treated strips were a minimum of ten rows wide to reduce the effect of application inaccuracy and edge effects. The strips were also large enough to yield at least 35 tonnes of sugarcane, which was the minimum sample size requested by the mills for individual CCS measurement. The exact configuration of treated and untreated strips varied depending on field shape, row length, row width and expected cane yield.

For the second option, the Herbert district was divided into five sub-districts based on amalgamating the existing 26 Herbert productivity groups. The five sub-districts were chosen on the basis that farms within each sub-district shared a similar range of soil types, sugarcane varieties, climate, agronomic practices and growing conditions.

The growers who signed up for the pilot study and successfully completed the accreditation program nominated potential MODDUS® blocks. The nominated blocks were inspected and within each sub-district four were chosen to become MODDUS® benchmark fields. The number and location of benchmark fields were determined to ensure they were representative of all fields in the pilot program.

Preliminary trials indicated that sugarcane variety has a significant influence on the magnitude of the CCS response to MODDUS®, so two of the chosen benchmark fields were ‘responsive’ varieties and two were ‘variable response’ varieties. Thus there were 20 MODDUS® benchmark fields in the Herbert district.

Growers who elected to use the benchmark option were charged product costs based on the average CCS increase measured in the ‘responsive’ or ‘variable response’ benchmark fields within their sub-district, depending on whether their particular variety(s) was classified as ‘responsive’ or ‘variable response.’

**Statistical analysis of trials**

To compare the mean CCS and cane yields, an ANOVA was undertaken using PHStat2.

**SIIF funding**

CANEGROWERS Herbert River organisation (with support from 2006 Herbert MODDUS® Pilot working team), successfully applied for funding through the Queensland State Government Sugar Industry Innovation Fund. The funds granted assisted growers in meeting aerial application costs associated with the pilot program.

**Results and discussion**

**CCS response to MODDUS®**

From previous research undertaken in 2004 it was found that some sugarcane varieties responded better to MODDUS® than others (Di Bella et al., 2004). McDonald et al. (2001) also reported that the factors affecting the response of ripeners is not fully understood, however it is believed to be variety dependent. Varieties were classified as responsive or variable based on their responsiveness to MODDUS® determined in earlier trials.

Varieties such as Q152 and Q174® were classified as ‘variable’ responsive varieties because on average these varieties showed a lower increase in CCS following MODDUS® application when compared to ‘responsive’ varieties. However, ‘variable’ varieties still
responded to MODDUS® applications under certain conditions, although results were not as consistent as those found with responsive varieties. The ‘responsive’ varieties typically had lower average CCS, higher yields and were later maturing. Examples include Q138, Q157, and Q179™ (Anon., 2006).

Figure 1 highlights the difference between ‘variable’ and ‘responsive’ varieties in the 2006 Herbert MODDUS® pilot program through the use of a ‘Box and Whisker’ plot, developed using PHStat2.

The ‘Box and Whisker’ plot divides the data set into quartiles and highlights the spread of data obtained. A Box and Whisker plot shows quartiles: one quarter of the values lie between the top whisker and the top of the box; one quarter above the median line within the box; one quarter below the median line within the box; and one quarter between the bottom of the box and the bottom whisker (Ott, 1988).

The box extends from the 25th percentile to the 75th percentile, with a line at the median (the 50th percentile) and the whiskers extend above and below the box to show the highest and lowest values obtained (Ott, 1988).

![Box and Whisker Plot](image)

**Fig. 1—Variable and responsive varieties in the 2006 Herbert MODDUS® pilot program.**

Figure 2 shows the spread of the CCS results obtained for each variety when comparing treated and untreated cane. The median CCS values for treated and untreated Q174™ are not different, whereas the other varieties all show a higher median for the treated than the untreated. This indicates that a Q174™ is less responsive than the other varieties.

When mean values are considered, Q174™ is the least responsive variety in the Herbert with an average increase in CCS of 0.33 units. In contrast, Q157 showed an average increase of 0.95 units. Figure 3 shows the average increase in CCS for all major varieties supplied in the Herbert program.
Fig. 2—CCS results for five treated and untreated cane varieties: Q174, Q162, Q158, Q157 and Q152.

Fig. 3—Increase in mean CCS values of major varieties in the Herbert after treatment with MODDUS® in the 2006 pilot program.
MODDUS® is a useful management tool to allow growers to increase early CCS and allow the harvest window of a variety to be moved forward.

**Yield response to MODDUS®**

At harvest, a number of growers were concerned that MODDUS® may have decreased crop yield. This concern was due to the shorter appearance of the MODDUS® treated cane. This visual effect on appearance was attributed to the stunting of the cane top, leaves and flowers due to the MODDUS® application. (Anon., 2006). However, at harvest there was no significant difference in cane yield between the treated and untreated cane, as determined at the mill weighbridge.

Figure 4 shows the average cane yields for treated and untreated cane for the 2004–2006 seasons in the Herbert. Di Bella et al. (2004) showed that there was no statistical difference in cane yield for the trials conducted in 2004.

![Fig. 4—Average cane yields for treated and untreated cane in the Herbert.](image)

**Monetary returns**

In the Herbert, an average CCS improvement of 0.7 units across the district was achieved in 2006 for early harvested cane. Individual grower CCS responses ranged from nil to as high as 1.8 units. On average, a gross increase of $2.68 per tonne of cane was achieved from the MODDUS® application. Table 1 highlights the increased gross value for MODDUS®.

**Table 1**—Monetary returns for MODDUS® application in 2006 early harvest trials (Anon., 2006).

<table>
<thead>
<tr>
<th>Region</th>
<th>Average CCS increase</th>
<th>Average cane yield (t/ha)</th>
<th>Average sugar yield increase (t/ha)</th>
<th>Average increase in gross value* ($/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Herbert</td>
<td>0.70</td>
<td>78</td>
<td>0.55</td>
<td>$209</td>
</tr>
</tbody>
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Calculations based on the estimated sugar price = $380/t sugar
Visual appearance of the crop

In the 2006 pilot program the following visual effects were noted:

1. Inhibition of flowers on some treated fields.
2. The stunting of newly emerging flowers.
3. Slight yellowing of the green canopy approximately 14 days after the application of MODDUS® in some varieties (Q158 and Q179). The canopy in most crops changed back to the original green colour within 30 days after application. This was also reported in the 2004 trials (Di Bella et al., 2004).
4. A reduction in stalk elongation and a shortening of the internode length in the treated plots.
5. A reduction in new leaf length of the treated crop when compared to the untreated crop.
6. A visual difference in the tiller height and tiller numbers in the subsequent ratoon crops similar to that reported by Di Bella et al. (2004). The ratoon tiller numbers in the treated areas were always significantly higher (between 40–50% more) than the untreated areas in the early ratoon stages. The visual effects were not evident by the harvest time the following year and there were no differences in cane yields as determined at mill weighbridge. (Anon., 2006).
7. Treated areas can be slightly slower to emerge when ratooning and generally new tillers appear darker green in colour.

Conclusions

The 2006 MODDUS® pilot program in the Herbert was successful in demonstrating the commercial worth of the product through a CCS increase and an increase in monetary returns to the grower. This effect has been achieved with no significant reduction in cane yield across the district.

The program has also suggested other potential benefits such as improved ratooning and an increase in nutrient and water uptake. The full potential of these benefits are not fully understood and will be investigated in subsequent work.

The pilot program allowed growers to assess the product’s commercial potential through the risk-share pricing model and be supported technically to maximise the potential for success.

The risk-share model enabled growers to manage risk associated with the variable responses that are sometimes achieved by the application of the product.

The pilot program has demonstrated that MODDUS® can significantly increase industry profitability and should be considered as a useful crop management tool into the future, particularly if areas are considering earlier starts to the harvesting season.

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REFERENCES


