

## Peer-reviewed paper

# Harvesting groups — the key to improving harvesting practice

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## Abstract

In the 2017 and 2018 crushing seasons, Sugar Research Australia Limited (SRA) conducted a project to assist harvesting groups to reduce sugar loss. The principles of harvesting practice to reduce loss have been well known in the industry for many years. However, at the start of the 2017 season few harvesting groups were operating according to these principles. The harvesting adoption team concluded that there were several socio-economic impediments to harvester operators changing practice, but that many of these could be overcome by working with individual harvesting groups (a harvester owner and the farmers serviced) as these could make decisions on changing arrangements. A demonstration trial evaluating sugar loss from a suite of harvester settings (typically commercial standard, recommended (guided by harvesting best practice (HBP) principles), aggressive and 'low-loss' control) was provided for each group involved, with all group members encouraged to attend. This was followed up with at least one workshop where the trial results and economic analysis were presented and groups were encouraged to consider improving harvester setup, optimising harvester settings to reduce loss and changing harvesting payment arrangements. In 2017, 43 groups were involved, and a further 52 in 2018. To date, the uptake of HBP harvester settings has been impressive. Groups that participated in the demonstration trials had, on average, reduced both fan speed and pour rates. Unfortunately, 50% of participants continued to operate above the generic recommended rates, which is reflective of the need for a robust estimate of the cost and benefits of harvesting to allow improved payment arrangements and acceptance by harvesting groups. Of the 40 groups for which data is currently available, 25 groups had optimised their harvester feed trains, 11 had installed after-market (low loss) choppers, 6 groups had changed payment arrangements and 20 were considering or negotiating changed payment arrangements. Many participants are now supporters of best practice; they accept that sugar losses are real, significant and able to be addressed. It is intended to continue this project into the 2019 through to 2022 seasons.

**Key words** Harvesting best practice, profitability, sugar loss, economics, harvesting costs, adoption

## INTRODUCTION

In July 2016, Sugar Research Australia Limited (SRA) commenced a major research and adoption program to improve the efficiency of the Australian sugarcane harvest sector. Titled '*Enhancing the sugar industry value chain by addressing mechanical harvest losses through research, technology, and adoption*' it receives funding from SRA and the Australian Government (Department of Agriculture and Water Resources). Other significant contributions come from the Queensland Department of Agriculture and Fisheries (QDAF), industry research bodies, milling companies, cane productivity services, harvester operators and growers. Across the project, investments include \$3.55 million from the Australian Government and \$1.85 million from SRA.

A major part of this program is SRA Project 2016/955, *Adoption of practices to mitigate harvest losses*. This project aims to encourage adoption of what has become known as HBP (harvesting best practices), which could be described as a set of guidelines to minimise cane losses by regulating fan speed and pour rate, dependent on factors such as crop condition, variety, field condition, whether cane is burned or green, and machine set-up.

Promotion of harvesting best practice has a long history in the industry. Linedale and Ridge (1996) reported on a “successful campaign to minimise harvesting losses” during 1992–1995. Agnew *et al.* (2002) ran a comprehensive series of trials and workshops looking at many aspects of harvester design and operation. These fed into the production of the first edition of the BSES *Harvesting Best Practice Manual for Chopper-Extractor Harvesters* (Sandell and Agnew 2002), which was updated in 2014 (Sugar Research Australia 2014). Industry interest in harvesting losses was given fresh impetus with a value chain analysis of the industry prepared by John Pollock in 2013 (Pollock 2013), which demonstrated the beneficial impact of adopting HBP across the industry as a whole. This led to the Australian Sugar Milling Council and SRA convening a harvesting loss symposium in 2015 and action by SRA to ramp up efforts in this area.

Despite identification of these losses, when the current project commenced in 2016 there was little evidence that significant change in practice was occurring and there were few groups in Australia committed to harvesting practices that minimised loss. Deterioration in many parameters of cane quality had been noted by Larsen *et al.* (2016), and Keeffe (2017) had conducted a survey of harvester operators and growers, seeking their views on the need for and impact of improvements to harvesting equipment. Participants (harvester operators and growers) who responded to the survey reported the following:

- 42% of contractors felt growers were not providing the best possible conditions to harvest their cane;
- 33% of growers felt their contractor was not providing the best possible harvesting service.

The reasons for slow uptake of HBP are complex, albeit familiar:

1. Lack of recognition of the scale of losses and opportunity to minimise them through improved practices. It has been stated that current machines are very good at disguising the losses in harvesting.
2. Harvester-owner expectations that there will be extra harvesting costs from changes to practice and a perceived inability to recoup them.
3. In some groups, lack of communication between the harvester operator and the farmers in the group concerning HBP.
4. Pressures on harvesting groups to harvest at high flow rates to ensure that bin allotments are filled.
5. A concern that large contracts, which already need to harvest over a significant part of the working day, do not allow for lower flow rates.
6. Pressure to maximise bin weights, leading to a perception of the need to shorten billet lengths in an effort to increase bulk density.
7. Concern that reducing fan speed would lead to an increase in extraneous matter (EM) and a subsequent loss of CCS.

Overcoming these impediments needed an innovative approach. With some exceptions, past efforts to reduce losses had involved advisors urging harvester operators to slow down and reduce fan speed, without taking into account the economic and social constraints. To affect change, it was necessary to involve those with the ability to make decisions – the harvesting group (defined as the harvester owner and the growers serviced) and not just the operator. The involvement of milling companies was also part of the approach, to ensure that mill requirements in areas such as billet length and trash levels were not in conflict with settings to reduce losses.

## THE PROJECT

The harvesting adoption project was initiated in 2016 and commenced demonstration trials and workshops in the 2017 season. Uncertainty around burnt-cane trial methodology restricted trials being undertaken in burnt-cane regions (Burdekin and New South Wales) until the 2018 season. The project aimed to undertake trials and workshops with 10% of all harvesting groups in each area covered in 2017.

Groups that participated in demonstrations in 2017 were volunteers, many of whom had indicated a willingness to explore HBP. This was a deliberate decision, as the adoption team identified that working with innovative groups early on would allow the processes and presentations of trials and workshops to be refined. The standard practices of the volunteer groups are likely to have been closer to HBP than those of operators in general and, hence, the results of changed practices may be an underestimate of what could be expected if there was similar uptake throughout the wider industry.

With the above principles in mind, interactions with harvesting groups were arranged as follows:

- Harvesting groups were invited to sign up for a trial, using entities such as regional productivity services to recruit volunteers. All members of the group were encouraged to participate in the trial with an expectation that growers representing at least half of the group's tonnage would commit to involvement.
- In a field belonging to one grower of the group, the adoption team ran a mass-balance trial together with the Infield Sucrose Loss Measurement System (ISLMS) (Whiteing 2013) to demonstrate the sugar loss, production and revenue outcomes from harvesting at different pour rates (ground speeds) and fan speeds. Patane *et al.* (2019) gives more details of these demonstration trials. All members of the group were encouraged to attend for at least part of the day (trials generally lasted around 12 hours).
- QDAF economists and SRA met with 13 of the harvesting contractors to collect detailed costs specific to each operation and trial block in order to evaluate the difference in harvesting costs from using HBP instead of standard practice.
- Trial data were analysed and economic analyses undertaken to showcase the relative performance of each treatment trialled (Patane *et al.* 2019; Thompson *et al.* 2019; Nothard *et al.* 2019).
- Results were presented at workshops facilitated by the adoption team, held towards the end of 2017 and during the first half of 2018. At the first of these workshops, groups were given the option for a follow-up meeting, which most accepted.

These workshops were pivotal to the adoption process. The growers had seen the trial and had an improved understanding of the outcomes from the different ground- and fan-speed combinations. In each workshop, the adoption team discussed various approaches through which change could occur, while reinforcing that harvester operators should not to be blamed for losses. Options put forward included:

- Reducing pour rate and fan speed;
- Use of decision tools available, such as the ready reckoner included in the HBP Manual (Sugar Research 2014) and the SCHLOT program that is on the SRA website (Sugar Research Australia 2018);
- Feed-train optimisation;
- GPS monitoring of ground speed;
- Chopper design and reducing the number of blades;
- Timing of maintenance of chopper and basecutter blades to ensure sharpness;
- Changing payment arrangements;
- Improving field conditions for presentation of crop.

As the workshops were vital in bringing about change, it was recognised that facilitators should encourage the group to make decisions around implementing change at the meetings. The adoption team reviewed the publication *How to Use Persuasion Skills to Drive Technology Adoption* by C-Qual Agritelligence (2012) prepared for the 2013 Sugar Advisory Services Development Program. The following were taken as principles for facilitating the workshops:

- Establish clear objectives – such as “Reduce losses and ensure that incentives are appropriate”;
- Know your product;
- Identify well-defined benefits and provide sound and credible evidence – the trial results provided these;
- Keep it simple and clear and focus on clarity not detail, providing enough data to support the goals;
- Propose specific actions – discussed above;
- Ensure practical implementation – from the facilitator's experience;
- Shrink the change – reduce expectations, build on current practice, break the change into steps and recognise successful steps.

The workshop facilitators asked decisional questions to encourage action – “What do you want to do?”, “What would allow you to make a decision today?” This was successful in moving groups towards change.

## EXPERIENCE SO FAR

The demonstrations and trials were designed to address impediments to adoption:

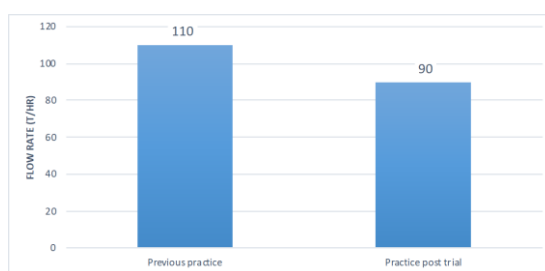
1. Recognition of the scale of losses and the opportunity to minimise them through changed practices. *This was addressed in the demonstration trial, where the participants noted the different distances the haulouts needed to travel to fill a bin under different treatments. It was then confirmed with the detailed reports at the workshops.*
2. Operator expectations that there will be extra harvesting costs from changes to practice and a perceived inability to recoup them. *This was addressed by the format of gathering the group together and the transparency provided by the economic analysis of the trial.*

3. In some groups, lack of communication between the harvester operator and the farmers in the group. *Also addressed by bringing the group together.*
4. A feeling of pressure to harvest at high rates to ensure that bin allotments are filled. *The economic analysis can assist in demonstrating the returns from reducing loss and increasing income, thereby allowing the harvester to be compensated for extra costs. See Thompson et al. (2019) and Nothard et al. (2019).*
5. The concern that large contracts, which need to harvest over a significant part of the working day, do not allow for lower flow rates. *Apart from the point above, the economic analysis considers time spent waiting for bins; slower rates can minimise this, allowing a smaller reduction in the daily offtake.*
6. Pressure to maximise the bin weights, leading to shortening of billets in an effort to increase bulk density. *This is not addressed during the individual trial, but the results of the overall trials can be used to demonstrate the fallacy of this assumption.*

These approaches have been successful in generating change. We have recorded the responses of each group and update these records as groups report new activity. Data has been gathered from group responses and from logged data, where available.

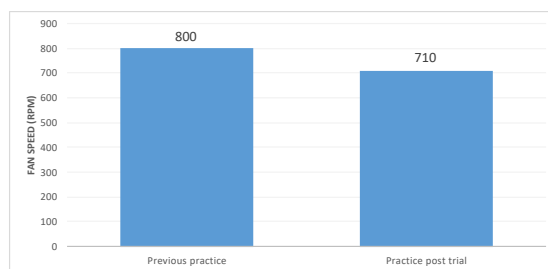
### POUR RATE, GROUND SPEED, FAN SPEED AND OTHER PARAMETERS

Groups that participated in the demonstration trials have, on average, reduced both ground speed (to reduce pour rates) and fan speed. Figure 1 shows the average product flow rate (machine-throat pour rate) that participants nominated as their previous commercial ‘standard’ practice at the trial, compared to rates adopted after the trial, obtained from data logs or responses at workshops. Many groups have reduced their pour rates, but 50% are still operating above the generic recommended rates – 90 t cane/ha for John Deere machines and 80 t cane/ha for Case machines. This is reflective of the need for a robust estimate of the cost and benefits of harvesting individual block under different pour rates, which enables harvester operators to adopt the best settings for most circumstances and receive appropriate payments.



**Figure 1.** Product flow rate before and after involvement in the project.

Groups have also reduced fan speeds; in a remarkable development, all operators that took part in the trials now run their fans at the recommended rate (800 rpm or below), whereas only 60% were doing so before the trials. Figure 2 shows the average reduction in fan speeds.



**Figure 2.** Fan speed before and after involvement in the project.

Of the 40 groups for which data is available:

- 25 groups have optimised their harvester feedtrains;
- 11 groups have installed after-market choppers;
- 6 groups have changed payment arrangements to encourage more efficient harvesting and 20 more are considering or negotiating better payment arrangements. Universally, all these groups have called for a decision-support tool that allows greater customisation than the SCHLOT demonstration or pour-rate ready reckoner from the SRA website.

We have received feedback from participants indicating that many are now supporters of best practice, and that they accept that sugar losses are real, significant and able to be addressed. However, groups have asked for further assistance to make the changes necessary to realise the benefits of HBP, with many requesting an improved decision-support tool.

## CONCLUSIONS

The rollout of this project has been successful, with significant adoption in the first year and the expectation that this will continue. The innovation of conducting individual demonstrations and facilitated workshops for groups, along with a comprehensive economic analysis, has given the project the ability to break through the barriers to change. More work will be required to provide industry with improved decision-support systems and to bring other elements of the value chain into consideration. Changes in harvesting output may present opportunities for mills to increase throughput and sugar production, but may also present challenges if, for example, capital investment in rolling stock and cane-receival facilities is required. Ongoing modelling and understanding of the implications of changes across the value chain will be the key to future success.

Sugar Research Australia has indicated it is willing to continue this activity. It has applied to the Australian Government for further funding for the 2019–2021 seasons that will allow continuation of the successful round of engagement with harvesting groups to further improve industry adoption and outcomes of HBP.

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