SRDC Grower Group Innovation Project
Final Report

SRDC project number:	GGP039
Project title:	Precision spot spraying system: it works in grains will it work in cane?
Group name:	Advance Burdekin Collective Research Inc
Contact person:	Joe Linton j.linton3@bigpond.com
Due date for report:	01/04/2012
Funding Statement:	This project was conducted by Advance Burdekin Collective Research Inc. (ABC) in association with the Sugar Research and Development Corporation (SRDC). SRDC invests funds for sugar R&D derived from the sugar industry and the Australian Government.

Australian Government
Sugar Research and Development Corporation

The Advance Burdekin Collective Research Inc. is not a partner, joint venturer, employee or agent of SRDC and has no authority to legally bind SRDC, in any publication of substantive details or results of this Project.

Body of Report

Executive Summary:

This project set out to test the suitability of new technology for precision herbicide application in sugarcane. WeedSeeker® sensors have been successfully used in broadacre situations; with individual case studies reporting herbicide reductions of more than 80%. Since most sugarcane fields have patches of grass and weeds, along with large areas that are weed-free, this technology offers an opportunity to reduce input costs and reduce our environmental footprint.

Our trial results showed that the WeedSeeker® sensor technology can work successfully in sugarcane crops. The WeedSeeker® technology did reduce herbicide usage and, just as importantly, it detected weeds and effectively sprayed them.

Savings in herbicide usage will vary from field to field, depending on weed pressure. Obviously the fewer the weeds the more savings will be made. Despite problems with the crop deflectors, the trials consistently showed herbicide usage of less than 50% compared to the standard GC shield, which sprayed the entire target area. Apart from the obvious saving in herbicide costs, other significant benefits of reduced labour, through reduced fill-ups as one tank will cover at least twice or three times the area, and larger areas able to be sprayed per day providing more timely weed control, should also be realised.

A simple economic study which only considered the herbicide cost saving, and not benefits from lower labour costs or the benefit to cane yield through more timely weed control, was undertaken. It is more likely that large farmers, or spray contractors, would be able to justify the cost to purchase the equipment. The longer payback period for a farmer with a small area may deter them from making the investment.

One of the benefits arising from the early modifications to the spray rig design, and sensor placement, was to reduce the number of WeedSeeker® sensors per shield from four to three. Clearly, the group under-estimated the effort required to modify the shields and crop deflectors. The current design of the crop deflectors is forcing a small number of cane leaves under the shield, and, as such, the WeedSeeker® sensors turn on herbicide at the wrong time. However, the group feels this is a problem than can be rectified and does not detract from the effectiveness of the precision technology.

Background:

The issue:

Sugarcane farmers are moving to minimum till and their reliance on chemicals will increase. This will have three effects:

- Growers' chemical costs will increase;
- In order to avoid a build-up of herbicide resistance, farmers will use a more extensive (and probably a more expensive) range of herbicides; and
- An increased potential for off-farm impacts.

WeedSeeker®, an optical spot spray system, introduced to Australia in 2002, has seen chemical costs savings of 80% in broadacre applications. The WeedSeeker® system has the ability to both reduce chemicals applied in the first instance and allow for the use of expensive chemistry to combat the resistance issues in the second, further to this in some areas woody weeds are present which require chemicals that can only be spot sprayed which by hand is labour intensive.

The Burdekin regional plan discusses the use of technology and the reduction of growing costs; this project has the potential to address these points.

Reducing costs associated with weed control is another way to improve the profitability of our farming business. Currently, we apply herbicide to 100% of the target area regardless of whether weeds are present or not. Every farmer knows that in most fields, there are significant areas where no weeds are growing. When using herbicides, like glyphosate and paraquat, this becomes a large amount of wasted herbicide and ultimately money.

The project was conducted to determine the feasibility of using weed detecting technology in the sugarcane industry.

Aims:

This project will seek to:

- Develop a spray hood system utilising optical spot spray sensors (WeedSeeker®) for the cane industry.
- Determine the cost benefit from the uptake of WeedSeeker® technology.
- Expose group members to new technology and will learn how it can be utilised to maximise profitability.

Methodology:

A 4 row boom spray was modified by adding hoods and 4 WeedSeeker® sensors beneath each hood. Crop Optics Australia provided advice on the number and positioning of sensors.

Initial field testing of the WeedSeeker® spray system highlighted problems with spray mist causing the sensors to operate incorrectly. A long period of modifications and field testing occurred until the final design resulting in repositioning the sensors outside the spray chamber and reducing the number from four to three (Figure 1).

Figure 1. After modifications the three sensors sit outside the spray chamber.

Field trials were conducted comparing the WeedSeeker® spray rig with a standard shielded sprayer. The amount of herbicide used and the effectiveness of herbicide application were recorded. Unfortunately, the shields, on the new spray rig, did not provide the level of protection to cane leaves as expected; Figure 2, right picture, shows the typical herbicide damage experienced during the trials. As a result some level of herbicide damage occurred, and most trials were conducted with paraquat rather than the preferred glyphosate.

Finally, some basic economics to examine the time taken to recoup the initial investment through herbicide savings was conducted.

Results and Outputs:

Did the WeedSeeker® system kill all the grass and weeds?

Yes, compared to the conventional shielded sprayer (GC shields) the kill was just as effective (Figure 2).

Did the WeedSeeker® system use less herbicide than the conventional GC sprayer (which sprayed 100% of the targeted area)?

Yes, across the trial fields usage was less than 50% of that used in the GC shielded sprayer. However, the amount saved could have been much higher if the current shields prevented cane leaves from triggering the spray. Highlighting this problem are the results (Table 1) from one of the field trials where weed population was estimated at 25%.

Figure 2. Weeds kill was just as effective using the WeekSeeker technology (right) compared to the GC shields (left).

The results from one field trial are reported in Table 1. The trial used glyphosate at a rate of 3.0 L/ha, surpass 475 at 1 L/ha, and LI-700 at 100 mL/100 L of water. The shielded sprayers covered the entire inter-row area, which is approximately 50% of the field area. Even though extra herbicide was applied, due to leaves going under the crop deflectors, herbicide savings were realised (Table 1).

Table 1. Amount of chemical used and savings made by using the precision technology.

	Amount of product used (L/ha)		Amount saved (L/ha)
Chemical	WeedSeeker®	GC shield	
RoundUp PowerMAX	0.9	1.5	0.6
Surpass 475	0.3	0.5	0.2
LI-700	0.03	0.04	0.01

Economics

The field trials had indicated the WeedSeeker® technology was effective in identifying and spraying weeds. However the herbicide usage was not accurate because the field trials were being affected by a design fault in the crop deflectors. The group decided a desktop study on economics was more appropriate.

Potential savings from reduced herbicide usage was determined based on Roundup PowerMax at three rates (3, 2, 1 L/ha) which reflected a high, medium and low weed pressure, and LI-700 used at 100 mL per 100 L sprayed; the herbicide was sprayed at 100 L/ha. Table 2 and Figure 3 are based on the following costs (excluding gst):

- Roundup PowerMax @ $6.95 /L
- LI-700 @ $9.20 /L

On a 1.8m row spacing the shielded sprayers will apply herbicide to approximately 50% of the entire field (i.e. the inter-row area only). Using these products and rates, the herbicide cost for the conventional shielded sprayer would be $3.94, $7.41 and $10.89/ha for the low, medium and high rates (Table 2). If the WeedSeeker® system sprayed only 40% of the inter-row, then the herbicide cost would be reduced to $1.57, $2.96 and $4.35/ha respectively (Table 2); creating a herbicide saving of $2.36, $4.45 and $6.53/ha respectively (Table 2 and Figure 3).

Table 2. Expected herbicide costs ($/ha) through spraying a reduced area.

	Herbicide cost ($/ha)		
% of inter-row area sprayed	Low	Medium	High
100	$ 3.94	$ 7.41	$ 10.89
90	$ 3.54	$ 6.67	$ 9.80
80	$ 3.15	$ 5.93	$ 8.71
70	$ 2.75	$ 5.19	$ 7.62
60	$ 2.36	$ 4.45	$ 6.53
50	$ 1.97	$ 3.71	$ 5.44
40	$ 1.57	$ 2.96	$ 4.35
30	$ 1.18	$ 2.22	$ 3.27
20	$ 0.79	$ 1.48	$ 2.18
10	$ 0.39	$ 0.74	$ 1.09

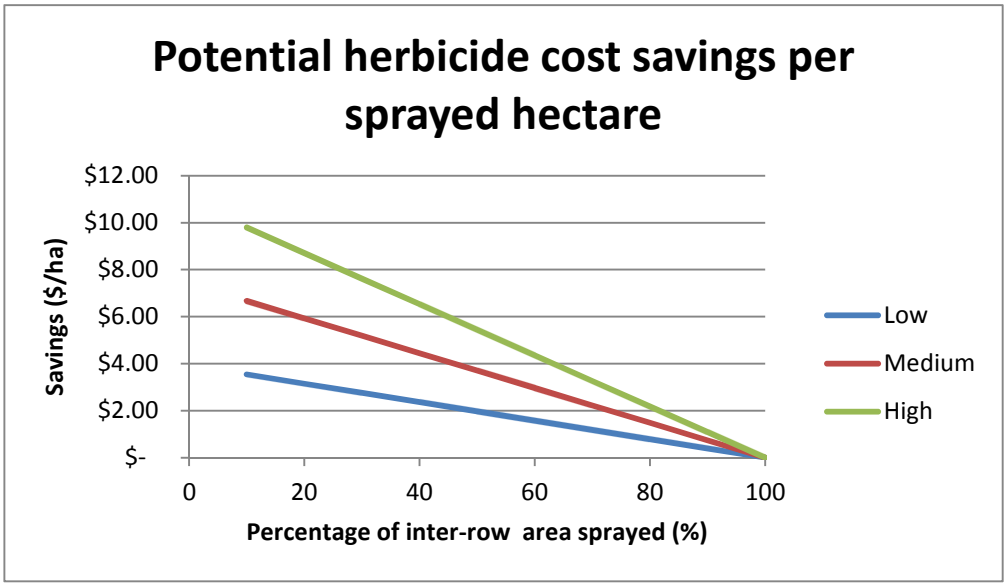

Figure 3. Savings in herbicide costs increase significantly as the sprayed area decreases.

Will the herbicide savings pay off? This depends on the amount of area sprayed each year and the reduction in herbicide usage. A simple analysis was conducted using the herbicide products and rates stated above, and assuming a cost of $30,000 for 18 WeedSeeker® sensors units, a controller and installation, and 1,000 hectares sprayed annually with shielded sprayers fitted with the WeedSeeker®. The analysis did not take into account any labour savings through reduced fill-up time or borrowing costs. Figure 4 shows that the time taken to recover the $30,000 could be as short as around 3 years when only 10% of the inter-row area was sprayed at the high herbicide rate. Conversely, the lower the herbicide rate and the greater the area sprayed, the longer it takes to repay the initial investment. This project did not look into the ongoing maintenance or replacement costs of the sensors.

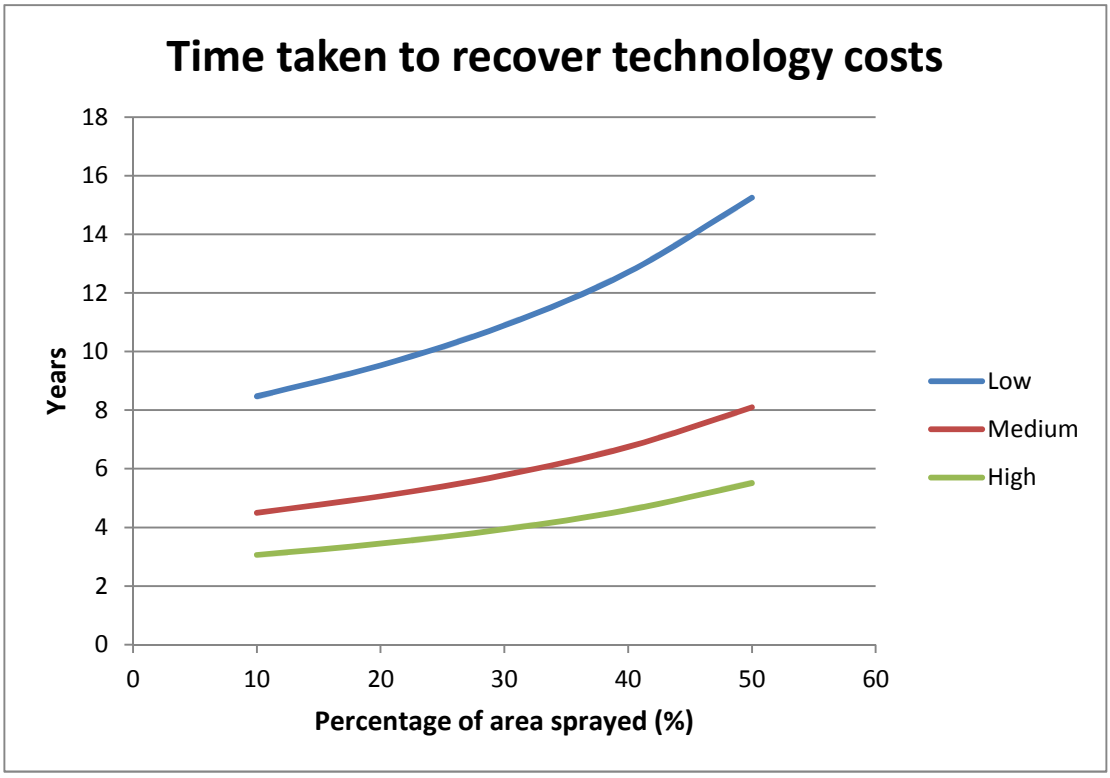

Figure 4. Time taken to recover cost of WeedSeeker sensors and installation assuming 1000 hectares was sprayed annually.

Design issues

The early designs of the spray rig encountered significant problems.

Problem 1: WeedSeeker® sensors were being turned on without weeds being detected. Spray mist, inside the hood, was covering the sensor 'eye' causing it to turn on and spray. This was resolved by relocating the sensors outside the shield. In doing so, the sensors were positioned higher and the number per inter-row was reduced from four to three (Figure 5).

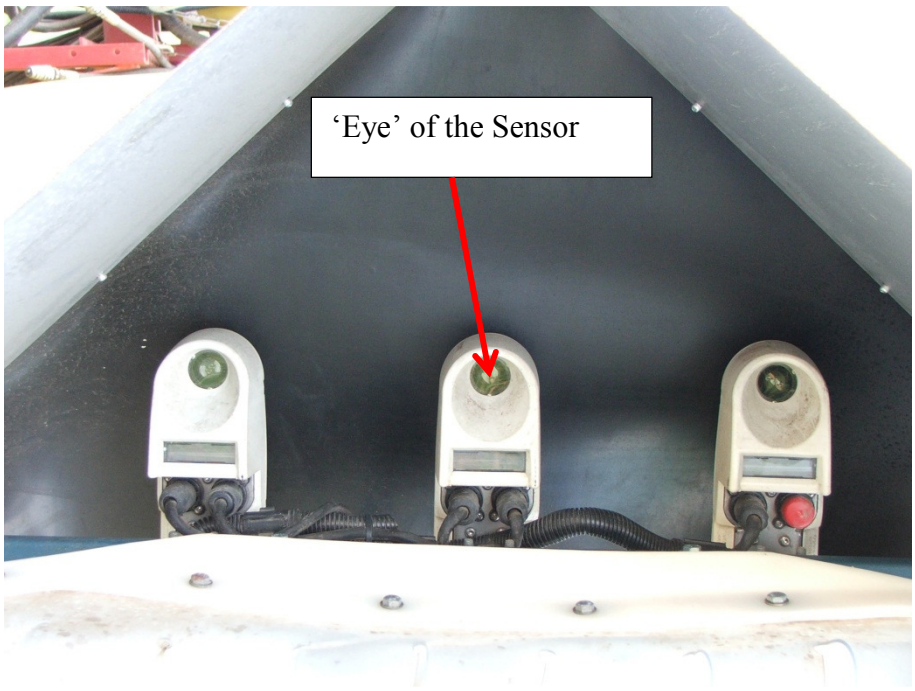

Figure 3. The 'eye' of the sensor needed to be protected from spray mist. The sensors are now located outside the spray chamber.

Problem 2: Cane leaves were pushed under the hood rather than away from (Figure 6). As a result, herbicide damage was clearly evident on cane (see Figure 1 (right picture). While this may be acceptable when using products like paraquat, using glyphosate was seen as too risky.

Figure 4. Cane leaves caught by crop deflectors, caused the sensors to spray herbicide unnecessarily.

Intellectual Property and Confidentiality:
Not applicable.

Capacity Building:
This project has taken much longer to complete than anticipated due to many issues, including unusually wet weather and design problems. However, the group has been able to work together and resolve these issues and continue through to complete the project. Group members have collaborated with staff from Mackay BSES/MAPS/AgriServ, who are working on a similar project. Both groups are tackling the issue of better crop deflectors and are benefitting from each other's experiences. Both projects will continue to share information and refine the spray units.

Outcomes:
Economic Benefits: The benefits become clearer as the total area sprayed gets larger and also as the weed population becomes less. For large land holders or spray contractors, this technology could produce cost savings through reduced herbicide costs and labour savings through fewer tank fills (more area covered per tank). For the smaller farmer, while savings through reduced herbicide usage will occur it may be difficult to justify the initial capital cost and then replacement.

Environmental Impact:
While water quality monitoring was not part of this project, it is expected that this technology will improve environmental outcomes through reduced usage of herbicide. Lower herbicide usage will produce lower losses from the paddock.

Communication and Adoption of Outputs:
Joe Linton presented the results of this project at the 2012 G.I.V.E. in Yamba, NSW. Results have also been communicated through discussions at the local CPI meetings and Project Catalyst meetings. The spray rig has been made available to any growers wanting to conduct their own trials.

Recommendations:
Individual farmers will need to carefully assess the economic benefits before deciding to invest in this technology. The benefits become clearer as the total area sprayed gets larger and also as the weed population becomes less. For the smaller farmer, while savings through reduced herbicide usage will occur it may be difficult to justify the initial capital cost and then replacement.

Publications:
None