

Intelligent Spray Control System

BY SMART APPLY



HINKLER AGTECH INITIATIVE

A CASE STUDY BY CENTRAL QUEENSLAND UNIVERSITY



This trial was undertaken as part of CQUniversity's Hinkler AgTech Initiative.

The Initiative aimed to increase the productivity and profitability of the Bundaberg region's agricultural sector through greater availability and utilisation of agricultural technology (AgTech).

An extensive consultative process undertaken with agribusinesses identified on-farm needs that may be addressed using AgTech. Trials of selected AgTech products and services were then undertaken in partnership with agribusinesses and technology providers to determine the technologies' efficacy in on-farm conditions.

This case study provides an overview of findings from one of the technology trials, including grower feedback and considerations for other growers when deciding whether to utilise the technology in their own enterprise.



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Introduction

Australian agriculture is seeing a rapid emergence of new technologies that are changing traditional farming practices. Agricultural technology (AgTech) promises improved productivity and yield and the ability for growers to make better decisions, but the rate of uptake of AgTech remains impeded by several factors. These factors include a lack of awareness by growers of potential technology solutions, difficulty in evaluating the on-farm efficacy of technology and a gap between grower needs and technology developments. The aim of this summary is to assist growers by providing background information on a commercially available technology, including details of its performance and value proven through on-farm trials.

The Smart Apply Intelligent Spray Control System™ (Smart Apply System) is a variable rate spray system that can be fitted to air blast sprayers for use in tree and vine crops. Smart Apply uses a LiDAR sensor to map the canopy area and foliage density and can automatically adjust either the area sprayed, or the applied spray volume based on the canopy area and foliage density detected. The system uses this information to automatically control the amount of spray medium being applied to vine and tree crops. Canopy data collected by Smart Apply is uploaded to a web-based platform where a grower can access it for reporting and planning purposes. Smart Apply is based in the USA and is represented by various agricultural equipment dealers throughout Australia and internationally.

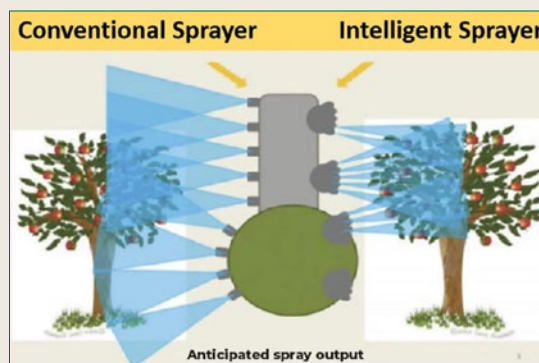


FIGURE 1: Comparison between conventional and 'smart' spray methods

FIGURE 2: Example of Complete Smart Apply System



What Does the Technology Deliver?

The Smart Apply System delivers variable rate spraying and precision data capture to growers of tree fruit and nuts, wine grapes and nurseries. It enables growers to apply crop protectant sprays only where necessary, reducing input costs and waste.

Data collected by the system includes date and time of spraying, spray volumes, tree counts, canopy volume of individual trees and area sprayed. This data is uploaded and stored in the Cloud where it can be accessed by the farmer at any time to assist with regulatory reporting requirements, crop health analysis, assessment of chemical use and savings and general operational planning.

The Smart Apply system also helps minimise the environmental impact of spraying operations. By reducing overspray and drift, it decreases the amount of chemicals released into the air and surrounding areas, thereby reducing pollution and potential harm to beneficial organisms.

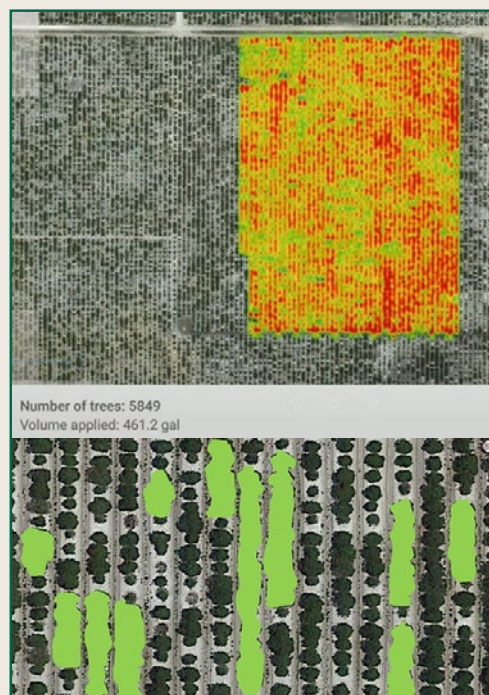


FIGURE 3: Example of Heat Map Produced by Smart Apply System

What is Required from the Grower?

The Smart Apply System is sold as a kit to be retrofitted to a grower's existing spray unit, so growers should first contact their local Smart Apply agent to determine if the unit is compatible.

Each 'Smart Apply' fit out is a bespoke installation, so final pricing will vary according to the type of spray rig used. A price of \$60,000, including installation and initial support by a

Smart Apply agent, is indicative for installation on most compatible, high-volume spray units deployed in the permanent cropping sector.

A grower will also need to familiarise themselves with Smart Apply's software that is provided with each spray unit, to ensure they are able to monitor its performance. Smart Apply's agents assist with set-up and operation requirements.



FIGURE 4: Spray Data Analysis at your Fingertips

How Does the Technology Work?

The Smart Apply System uses LiDAR sensors mounted at the front of the spray unit to detect the position, size and density of tree canopy on either side of the spray unit as it is driven between rows. The spray application rate is adjusted via solenoid-controlled valves on the spray nozzles, based on the detected density of the canopy and tractor speed.

The Smart Apply system can be configured to either 'section control' or 'density-based control' spray application. In section control mode, chemical is applied only when the LiDAR sensors detect tree canopy. The number of spray nozzles activated varies according to tree height and specific nozzles are switched off when the unit is passing gaps between trees. This control method is most beneficial to younger orchards with larger spacings between trees. In density control mode, the flow rate is adjusted based on canopy density (i.e., more spray is applied to areas with denser foliage).

Farmers can use an Android tablet to automate the spraying process by adjusting settings and chemical application rates. There is also an option to switch to manual spraying. Smart Apply captures data such as chemical volumes applied, speed, chemical savings, tree/vine counts and operator performance. The data is uploaded to the Cloud and archived and can be accessed by the grower at any time.

The Smart Apply System also enables advanced tree mapping and reporting and heat mapping data to be uploaded in real-time to the Cloud. When spraying is complete, a farmer can review the map to see exactly where the system was on or off, enabling them to focus on areas of the orchard that require additional attention. Spray coverage data may also be combined with localised weather data to

provide coverage reports, eliminating the need for manual calculations when submitting regulatory spray reports. Once the boundary of a particular farm or orchard has been input to the system, comparisons of historical growth rates in various sectors can be developed. Crop density heat maps enable a farmer to identify possible plant or tree stress areas, including sectors that might need additional irrigation or fertilization to increase plant density.

Smart Apply also gives growers the option of sharing their data with John Deere's Precision Ag Operations Centre. This integration unlocks another level of crop insights and expert support to advance a grower's productivity and profitability.

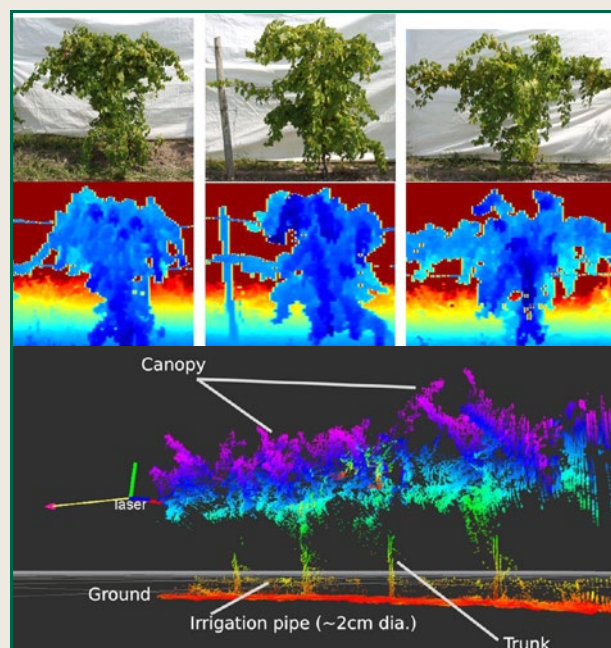


FIGURE 5: Example of LiDAR Image Captured by Smart Apply System

Technology Provider

The precision spray technology that is the foundation of the Intelligent Spray Control System was developed by the United States Department of Agriculture (USDA). In 2018, Smart Apply was selected by USDA to commercialise the technology and in 2020, Smart Apply introduced the Intelligent Spray Control System to the market.

The Smart Apply System is sold through a large network of Smart Apply authorised dealers around the world. John Deere is an authorised dealer in Australia and provides a complete sales and support service, including installation and testing, as required by the grower.

Applications of Technology (Current and Potential)

The Smart Apply System can be used to control a range of spray mediums applied to fruit and nut orchards, vineyards and tree nurseries.

Numerous trials of the Smart Apply System, undertaken as part of its development in the USA, demonstrated significant savings in chemical costs, greater spray accuracy and less wastage, for various crop/spray medium combinations.

For example, field trials in six commercial tree nurseries demonstrated that the Smart Apply System reduced average pesticide use between 46 and 68%. Additional tests in an apple orchard demonstrated that the Smart Apply System reduced spray loss beyond tree canopies between 40 and 87 percent, airborne spray drift by up to 87 percent, and spray loss on the ground between 68 and 93 percent.

Since being launched in Australia in 2021, the Smart Apply System has been deployed on several fruit orchards and vineyards in South Australia and vineyards in Victoria. With assistance from CQUniversity's Hinkler AgTech Initiative, RDO Equipment conducted a 'proof of concept' demonstration of the Smart Apply System in a commercial macadamia orchard. The system was mounted to a small ATV and configured to simulate a commercial tower spray fan.

This unit was trialed on three separate blocks consisting of small trees (2-3m high), medium trees (4-6m high) and fully mature trees (6-7m high) respectively. Data were collected for both 'section control' and 'density-based' variable spray control methods.

In section control mode, the Smart Apply System successfully restricted spray application to the tree canopy area by shutting off all nozzles when detecting spaces between trees in young orchards, or by shutting off upper nozzles on the tower sprayer for shorter trees. Spray medium volumes were reduced by 65%, compared to conventional (blanket) spraying.

In density-based control mode, savings in spray volume were estimated at 77% in young orchards, compared to conventional spraying. This saving decreased to 16% in mature orchards due to denser and more uniform canopies.

Based on these demonstration results, the grower installed the Smart Apply system on their existing tower spray unit and continues to use it on a fully commercial basis. RDO Equipment and CQUniversity are continuing to conduct on-farm field trials of the system and will publish the results upon their completion.



FIGURE 6: Prototype 'Smart Apply' Spray Rig Used in CQUniversity Trial



FIGURE 7: Smart Apply System Being Used on Air Blast Sprayer



FIGURE 8: Smart Apply System Being Used in Bundaberg Lemon Orchard



FIGURE 9: Density Spraying of Young Orange Orchard

Value of Technology

In addition to the cost-savings resulting from less chemicals being needed by the Smart Apply System, the number of trips required to refill spray tanks and measure chemical is also reduced and the efficiency of spray operations is significantly improved. The effectiveness of the crop protectant applied may also be improved by optimising application rates according to crop canopy (area or density). These outcomes help to minimise the environmental impact of chemical applications and prolong the effectiveness of pesticides against pest or pathogen populations.

The data collected during operation of the Smart Apply System can also help growers to identify areas of poor tree health and investigate potential issues. This data can also be used to relate yield data to canopy area/density and to inform pruning or other crop management practices. The data can also be analysed to monitor which sections of an orchard or nursery the farmer has sprayed, and which sections remain to be sprayed. This analysis assists with labour scheduling and improves overall efficiency of farming operations.

Additional Considerations

Although the Smart Apply system can be retrofit to most brands of suitable spray unit and towed by any brand of suitably equipped tractor, John Deere users have the additional benefit of being able to integrate data from the Smart Apply system into the John Deere Operations Centre. This feature helps growers easily and efficiently analyse past work, to help guide future business decisions. Available tools in the Operations Centre can be used to analyse, edit and make collaborative decisions from the same set of information to improve yields and reduce input costs.



FIGURE 10:
Example of
Smart Apply
Spray System

REFERENCES AND INFORMATION SOURCES



For further information on this trial and results, email CQUniversity's agricultural research team:

agriculture@cqu.edu.au

Information regarding the Smart Apply and their products, including pricing, case studies, grower testimonials and contact details, is available at:

smartapply.com

Summaries of other technology trials undertaken through the Hinkler AgTech Initiative are available at:

bundabergagtechhub.com.au



Australian Government



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