HINKLER AGTECH INITIATIVE

Use of Unmanned Ground Vehicles in Horticulture

INTRODUCTION

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 summary 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.

Background

Australia's horticultural sector is facing a range of challenges from rising input costs, labour shortages and more stringent workplace health and safety regulations. Many tasks currently undertaken by manual labour are tedious, repetitive and subject to risks. In the face of these challenges, growers are turning to technologies capable of performing these tasks more cost effectively and safely, while freeing up existing labour forces to do other tasks.

The Technology

The XAG R150 is a compact (1.4m long, 0.9m wide, 0.8m tall and 120kg) unmanned ground vehicle (UGV) designed for agricultural applications. The R150 uses a combination of global positioning satellite (GPS) and real-time kinematic (RTK) positioning to navigate autonomously. It can also be operated remotely via a ground station, allowing the operator to adjust the vehicle's course or speed as needed. The vehicle is highly maneuverable, with four-wheel drive and all-terrain capabilities and powered by a rechargeable lithium-ion battery that provides up to 4hrs of continuous operation on a single charge. While the R150 is designed primarily for agricultural applications such as spraying, spreading, and mapping, it can also be equipped with camera technology to undertake crop monitoring tasks, or used to tow equipment such as slashers. The vehicle has a maximum payload capacity of 150kg, which includes the weight of any equipment or chemicals that it carries.

The Trial

Two XAG R150 UGV units were deployed to carry out a range of on-farm tasks in three different cropping systems:

- Spraying, slashing and data capture within a commercial blueberry crop grown under semi- protected poly tunnel structures
- Spraying, disinfection and slashing within a commercial greenhouse operation exclusively growing cucumbers under steel and plastic structures
- Slashing and weed spraying in a mature macadamia orchard.

An RTK base station was installed at each property to enable autonomous operation.

RESULTS

The R150 performed most successfully in the commercial blueberry crop. The row spacings were ideal for the vehicle, allowing plenty of room to maneuver and turn around at the end of each tunnel. Connectivity was also reliable throughout the operation, with the unit able to connect easily and operate autonomously. The blueberry grower has since fitted the R150 with high-resolution cameras so it can collect yield data as it performs other tasks.

Within the greenhouse operation, the R150 was able to communicate with the base station easily, enabling successful autonomous operation. However, the plant rows were too narrow for the vehicle to turn around, and because the vehicle cannot reverse in autonomous mode, it would shut down when reaching the end of a row.

The vehicle performed all tasks successfully within the macadamia orchard, but only while being manually operated via the remote control. In autonomous mode, the vehicle was unable to communicate with the base station through the dense macadamia trees, resulting in the unit shutting down mid-task. Setting up autonomous routes for the vehicle also proved to be difficult due to the lack of connectivity and the grower noted that the vehicle's autonomous operation system was not very user friendly.

Value to Business

The growers involved in this trial commented that the reliability of autonomous technology to complete the task when required is of immense value to their businesses. The cost of manual labour is a significant contribution to rising input costs faced by growers. Autonomous vehicles have the potential to reduce this cost, and address the increasing difficulties associated with labour management. Sourcing and retaining reliable staff to undertake what are perceived to be 'low skilled' and 'undesirable' on-farm tasks is challenging for growers, yet it remains vital that these tasks are completed in a timely and effective manner.

The greenhouse growers also commented on the safety benefits gained from removing the need for manual operation of spray equipment in confined spaces. An autonomous vehicle provides great value to the working conditions of workers in these environments by eliminating the need for them to be within the greenhouse structure to complete a crop spray or disinfection application.

The cost of a basic XAG R150 vehicle, as deployed in this trial, is $26,000* and a spray kit including tank and diffusers is an additional $3,500*. The cost of a small tow-behind slasher ranges from $3500* to $5000*.

Grower Feedback

Trial Summary Questions	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I see value in this technology			✓		
I found the technology easy to use		✓			
The technology was easy to integrate within my business	✓				
I was satisfied with the service provided by the AgTech company				✓	
I intend using this technology in my business		✓			
I recommend this technology to other growers			✓		

Other Considerations

This trial has highlighted that successful deployment of UGV technology depends on the suitability of the farm to adopt this technology. Farm layout and infrastructure, including row spacings, structure types and accessibility are important considerations. If RTK connectivity is required for autonomous operation, then signal penetration through crops and structures is vital. For autonomous technology utilising types of connectivity technology other than RTK, the availability and quality of these connectivity services will also be an important consideration.

Autonomous operation is an emerging field in Australian agriculture, bringing with it a range of health and safety considerations. The XAG R150 vehicle trailed in these three cropping systems did not have any safety features to stop the vehicle if a collision with personnel or structures occurred. However, new versions of the unit include an 'emergency stop' feature, which deactivates the unit in the case of a collision. Other autonomous technology commercially available includes r safety features such as object detection and autonomous shut down procedures aimed at ensuring the safety of both workers and farm infrastructure.

Further Information

For further information on this trial and results, email CQUniversity's agricultural research team:
agriculture@cqu.edu.au

For further details on agricultural applications of unmanned ground vehicles, including the XAG R150, contact OzTech Drones, Bundaberg:
oztechdrones.com

Summaries of other technology trials undertaken through the Hinkler AgTech Initiative are available at:
bundabergagtechhub.com.au

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