Use of Drone Technology for Whitewashing Greenhouses

CQUniversity AUSTRALIA

HINKLER AGTECH INITIATIVE

A CASE STUDY BY CENTRAL QUEENSLAND UNIVERSITY

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 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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Background

The use of greenhouses for commercial horticultural production is becoming increasingly common throughout Australia, including central Queensland. Greenhouses provide a sustainable solution for food production and diminish many of the major issues associated with field-based farming, such as diseases, wind and temperature fluctuations.

With the advent of greater climate variability, particularly rising temperatures, one of the greatest challenges for growers is maintaining a stable and consistent environment within the greenhouse. If a greenhouse becomes too warm, root development, photosynthesis and nutrient absorption of crops are negatively affected.

The most common method of controlling temperature fluctuations in commercial greenhouses is the application of whitewash to greenhouse rooves or covers during warmer months. The whitewash reflects sunlight, enabling a more stable, cooler growing climate.

Traditional methods of whitewash application are time consuming, labour intensive and expensive. As the protected cropping sector continues to expand and greenhouse sizes increase, there is a clear need for an easier, safer and more cost-effective alternative.

FIGURE 1: Heat-stressed cucumber plants in greenhouse

FIGURE 2: A whitewashed greenhouse environment

Traditional Whitewashing Methods

The most common method of whitewash application involves manually brushing, rolling or spraying the liquid (hydrated lime mixed with water) onto the greenhouse cover.

This process is labour-intensive and time-consuming. It also poses significant health and safety risks due to the height of covers and potential inhalation by operators.

For large greenhouse installations, helicopters fitted with spray rigs are used to apply whitewash. This method is very quick but can result in significant spray drift due to the height the helicopter must fly above the cover.

Helicopter spraying can be relatively expensive due to the hire costs of aircraft and pilot, including flights time to and from base.

FIGURE 3: Manual whitewash application

FIGURE 4: Aerial whitewash application

Drone Technology

The use of drones, or Unmanned Aerial Vehicles (UAVs), is now common for a vast range of agricultural applications. The many advantages of drones include their low cost, lightweight design, accuracy and ability to be operated remotely. Drones fitted with storage tanks and spray units offer an alternative spraying method to traditional liquid applications, including whitewashing.

An XAG P30 Spraying Drone was deployed for this study. The XAG P30 is a state-of-the-art aerial spraying system, fitted with a fully automated flight control system with GPS capacity. This system navigates the drone at centimetre-level accuracy, enabling the user to spray precisely and only where needed.

FIGURE 5: XAG Detail and specifications

LIQUID CAPACITY	16l
Spray Width	2m-6m (Subject to dosage)
Spray Trend	Rotary atomizing nozzle
Droplet Size	90-55μm (Adjustable)
Coverage Rate	2000 m^2/hr
Maximum Flying Speed	12m/s
Hovering Accuracy (RGB Enabled)	Horizontal: +/-10cm Vertical: +/-10cm

Drone Technology

The XAG P30 is water resistant and holds 16 of liquid spray. The size and flow rate of the atomised droplets is managed by an intelligent centrifugation spray unit that responds instantaneously to commands. The unit can be easily adjusted to match the spray medium and required coverage rate. These features avoid spraying overlaps or missed areas.

The drone can also be used in conjunction with an automatic refilling system (Fig. 6) that automatically doses the required amount of liquid based on cloud task data. This system saves significant time for the operator and reduces exposure risks by avoiding direct contact between the operator and the spray medium.

A key feature of the XAG P30 is its use of use. The system includes an Android-compatible builit-in intercom, enabling the drone to be flown via a mobile smartphone.

FIGURE 6: XAG Auto Liquid Refilling Unit

Findings

For this study, an XAG P30 agricultural spray drone was deployed by a qualified contractor spray whitewash medium over 7ha of commercial greenhouse covers in the Bundaberg region. The grower had previously employed both manual and helicopter-based application methods.

FIGURE 7: Advantages of Drone Technology for Whitewashing

The drone performed reliably and successfully sprayed a consistent coating of whitewash over the entire cover in at a rate of 2000m2 /hr. Based on the results, the grower identified many advantages of the drone technology compared to traditional methods and now exclusively employs this technology, as summarised in Fig.7

An ongoing disadvantage of traditional methods of whitewash application is inconsistency in the coating thickness, particularly over large greenhouse covers. This inconsistency leads to varying levels of light and heat entering the greenhouse.

For manual application, the inconsistencies arise from the inability to access some areas comfortably and safely. For aerial application, the inconsistencies arise from excessive downdraft from helicopter rotors and overspray.

A drone's consistent speed, closeness to the greenhouse covers and ability to access all areas safely enable greater consistency as illustrated in Figure 8.

Findings

FIGURE 8. Before / After Results of Whitewashing with Drone

Table 1 summarises the comparative costs, and application times, of whitewash methods discussed in this study. These costs are exclusive of whitewash medium, which are a relatively small component of the entire process. These additional savings using drone technology are gained from efficiencies in spray application and reduction in spray drift. For this trial, the volume of whitewash medium used by the drone system was 40% less than the manual method and 60% less than the aerial method.

Whitewashing also reduces costs associated with ventilation and general energy management. Over the 10 years the grower in this study has been applying whitewash, they estimate that its application has resulted in 20-30 % greater crop profitability compared to no application.

As indicated by the figures in Table 1, manual application of whitewash may be a slightly cheaper option than drone or helicopter application but takes a considerably longer time. This presents challenges if a grower needs to re-apply the whitewash due to it being washed off during rain events (which also occur in the hotter months in Queensland).

OPTION	APPLICATION TIME	COST ($)
XAG P30 Drone Operated by qualified owner / operator, including all auxiliary equipment	35hrs	17,000
Manual Spraying	3 weeks	11,200
Helicopter Operated by qualified pilot, including flight time from/to base	N/A	30,000

TABLE 1: Comparative Costs of Whitewash Methods (Based on 7ha of cover)

An option not detailed in Figure 9 is the outright purchase of a spray drone system by the grower. The cost of a complete XAGP30 drone spray system (including all auxiliary equipment such as batteries, charger, tank, auto filler and pilot phone system) as deployed for this study, is $39,000. This may become a viable option if the drone is used for multiple purposes (e.g., crop spraying; property mapping, imagery capture etc. As discussed in the next section, there are additional legislative and compliance considerations involved in this this option.

Any Return on Investment (RoI) calculations regarding the options in Table 1, including outright drone purchase, or not applying whitewash at all, should account for all associated costs over the long term, including for example:

- *Training / licensing requirements to own and operate a drone (outright purchase)*
- *Depreciation on asset, including software updates (outright purchase)*
- *Any additional insurance costs associated with operating a drone within your enterprise*
- *Costs of time delays associated with re-booking helicopters and drone operators or rescheduling on-farm workforce (all options)*
- *Costs of crop deterioration if no application undertaken*
- *Costs of crop deterioration during longer times associated with manual application and any re-application, if required due to rainfall*

Other Considerations

In addition to cost and RoI considerations, there are a range of factors to be considered by growers before deploying a drone for applying whitewash. These include, but are not limited to:

REGULATIONS – *The most critical factors around drone deployment are the associated regulatory requirements. Anyone deploying a fully loaded XAG P30 drone as used in this study, will require a remote pilot licence and need to comply with rules outlined by the Australian Government's Civil Aviation Authority [CASA] (see link below).*

SAFETY – *In common with all aircraft, aerial drone flying gives rise to a range of safety issues. It is important that you ensure a safe work environment before deploying a drone.*

EXPERIENCE AND REPUTATION OF DRONE OPERATOR – *The number of drones and commercial drone operators operating in Australia's agricultural sector is increasing rapidly. As for any service provider, not all drone operators are equal. An operator's experience and skill are critical to them being able to provide a safe and cost-effective service. Many larger drone manufacturers, such as XAG, list recommended local operators on their web pages. CASA also maintains a list of all licensed drone operators on its website (see link below.)*

AVAILABILITY OF OPERATOR – *The availability of an operator on short notice may be critical when a grower wishes to re-apply whitewash after a rain event or remove it at the start of cooler months. Long wait times may result in lost production through lower crop yields.*

FIGURE 9: Example of Aerial Drone Flying Regulations

ADDITIONAL INFORMATION

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

For further information regarding drone rules and considerations when buying a drone, visit the Australian Government's Civil Aviation Authority (CASA) web page:
casa.gov.au/knowyourdrone/drone-rules

Complete specifications on the XAG P30 deployed for this study, and other products & services provided by XAG are available at:
xagaustralia.com.au

A range of research reports, publications and fact sheets on Australia's protected cropping industry, is made available by Protected Cropping Australia and Hort Innovation:
protectedcropping.net.au
horticulture.com.au

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

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