# Exploring the potential of remotely piloted aircraft

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Agricultural experts are exploring the potential of remotely piloted aircraft (RPAs) as a means of collecting cropping data in an efficient and unobtrusive manner.

RPAs can be fitted with cameras for aerial photography to record visual images or images obtained using specific parts of the light spectrum, such as near infra red (NIR) to obtain information about plant activity that is not evident to the naked eye or in standard photographs.

Common remote sensors that can be easily attached to drones include visible-spectrum, infra red and near infrared cameras and electromagnetic sensors. Visible and near infra red images are used to obtain the normalised vegetation difference index (NVDI) used to determine the vigour, vegetation cover and biomass of vegetation from crops to bush.

An NVDI map, showing growth in different colours, enables growers to identify poor-performing areas of crops, potentially leading to savings through the use of variable rate applications of herbicides, pesticides and fertilisers.

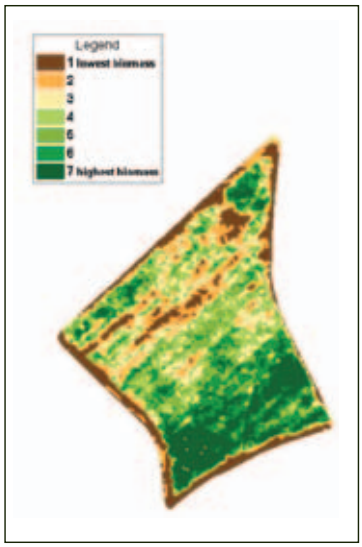
Cameras on RPAs can also provide detailed birds-eye visual images of paddocks that can reveal variations in crop colour or plant populations; opening the way for the grower to take action during the growing season to address the issues revealed by these variations.

Closer images and footage could identify in-crop pests such as red legged earth mite and or disease such as stripe rust.

Without such in-crop information poor yield is likely to be the first indication of a problem in the crop, and by then it can be very difficult to determine the cause of the problem, and whether it is paddock-wide or confined to a few areas.

Aerial images reveal the extent and location of any problems, and if nothing else, identify where to focus further ground-level scrutiny such as crop inspections, tissue and soil tests.

Researchers at Charles Sturt University and the University of Sydney are investigating a range of potential RPA applications, including differentiating weeds from crops. The weeds work, which could open the way for aerial spot spraying, involves use of a hyperspectral camera to identify the spectral 'signatures' of individual crops and weeds.




ABOVE: WHILE MUCH OF THE WORK WITH RPAs HAS FOCUSED ON DATA CAPTURE, THEY CAN ALSO BE USED FOR PADDOCK SPRAYING, WHICH OPENS THE WAY TO TARGET CHEMICALS ON AREAS WITH HIGH WEED OR DISEASE POPULATIONS.

ABOVE LEFT: RPAS CAN BE USED TO CAPTURE DATA INCLUDING NVDI IMAGES LIKE THIS ONE, WHICH CAN HELP IDENTIFY POORLY-PERFORMING AREAS WITHIN A PADDOCK.

Hyperspectral imagery can also be used to detect disease and the nutrient and water status of plants.

Near infra-red cameras can identify disease symptoms before they become visible to the human eye.

Early, in-crop detection of issues such as poor emergence, water stress, pests, diseases and nutrient deficiencies allows growers to deal with issues in their infancy.

Potential benefits of early action to address in-crop problems include improved yield gross margin in the current season and reduced chemical costs.

Aerial weed detection and spraying could reduce soil compaction and the labour and fuel costs associated with ground-based spraying.

**For those with a keen interest in this concept it is possible to build a small basic RPA for a few thousand dollars.**

## Expert or DIY?

Several consultancies are using RPAs to provide aerial imagery services in Australia, although none are known to be operating in SA at this stage.

Farmers considering limited use of this technology during critical growth stages could consider engaging a consultant, which would remove the need to buy one of these aircraft and develop the technical skills required to build and fly it. The skills to develop and analyse data from the images obtained may also be an issue.

For those with a keen interest in this concept it is possible to build a small basic RPA with weight point control, GPS guidance and auto take off and landing abilities for a few thousand dollars.

Growers running stock could use an RPA to monitor watering points, fence lines and animal numbers, which could further increase the value of on-farm RPA ownership.

The Civil Aviation Safety Authority (CASA) has laid down rules that RPA operators must follow.

A pilot's license is not required, but RPA users must apply for an operator's certificate that documents flight allowances and limitations. Operators need to submit details of use to CASA, including

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where and when they fly the RPA and what maintenance they undertake.

CASA's rulings limit RPA use to the 'visible line of sight' of the pilot unless a safety case is lodged and approved by the authority. RPAs must not be flown in a built up area and must be kept to a height of less than 152.4 m.

It is possible to obtain permission to spray crops from an RPA, but the spray equipment and modifications to the aircraft have to be approved by CASA.

### Big benefit or big brother?

In the UK the Rural Payment Agency, the national body responsible for paying farm subsidies and ensuring land use claims are legitimate, captures images and data about farmers who claim farm subsidies.

For many years the agency used satellite imagery to investigate farmers where 'there is some doubt about accuracy' because it is cheaper than using on-farm investigators. However, the accuracy of the satellite imagery came into question in 2001 when a farmer was wrongly accused of lying about planting a linseed crop, which was not detected in satellite images due to the reflection of nearby chalk deposits. The case against the farmer was subsequently dropped.

Elsewhere, RPAs are being used to monitor farm practises and verify actions for which farmers claim a subsidy.

The French government used RPAs to ensure that 'grubbing up' – the removal of vines to mitigate wine gluts – was done as per the paperwork submitted, a model that could be used in cropping systems where grower-claimed government tax breaks and payments for adoption could be verified using aerial imagery from RPAs.

RPAs potentially offer a more accurate view than satellites because sharper images can be taken from multiple angles, whereas satellite images are limited to one angle and image integrity can be affected by shadows, reflection and poor weather.

## RPAs OFFER MULTIPLE OPTIONS

Remotely piloted aircraft (RPAs), also known as un-manned aerial vehicles (UAVs) or drones, are small, pilot-less aircraft developed by the Americans for military operations including real-time surveillance.

Once the technology became available, other sectors including agriculture saw the potential for drones to be used for research and data capture. With the ability to attach devices such as cameras and sensors as required, RPAs quickly proved to be a low-cost means of recording information from the air without the need for full-sized piloted aircraft.

RPAs come in varying shapes and sizes, each with their strengths and weaknesses. Helicopters and octocopters (eight rotors) are easier to take off and land than aeroplanes, and don't require a runway.

These craft can be powered by fuel or electricity, with fuel giving a longer flight time, and can be controlled by remote control or pre-programmed using GPS coordinates.

## 'THE NEXT STEP' IN PA

Using remotely piloted aircraft (RPAs) is "the next step in precision agriculture," according to WA farmer Darrin Lee.

Darrin, who farms 6,500 ha at Mingenew, is working with a local consultant on the use of drones for capturing on-farm data he hopes will help him mitigate potential problems and increase on-farm efficiency.

Consultant Richard Riddle, who used RPAs in tobacco farms in Zimbabwe, suggested setting up a trial of RPA-based aerial imaging and feeding the information obtained into Crop Manager, a web-based software program that develops predictive information based on historical data.

"Using RPAs is another tool in the tool box", said Darrin, who also uses data from soil moisture probes and an on-farm weather station. "There is a lot happening on our property, so using a drone to capture paddock data in a timely and accurate way means we'll be able to identify potential issues earlier than usual".

Downloading information directly from an RPA into a farm management program also removes the need for manual data entry and potential operator error.

Darrin and Richard hope that combining information from the aerial monitoring with data from the on-farm monitoring tools already on Darrin's property will enable them to better predict yields, leading to improvements in grain marketing, better nitrogen and fertiliser decisions and higher profits.

Identifying potential disease and pest issues automatically and remotely is also on the agenda. "If the RPA picks up a problem in the crop, the program will send a text from the computer to my smart phone telling me to check a certain area for stem rust, for example, so I won't have to wait for obvious signs and a bigger chemical bill."

Darrin is optimistic the package approach to capturing data and creating useful information will also help him with quality assurance and identifying potential OH&S issues.

*For more information on CASA regulations go to http://www.casa.gov.au/scripts/nc.dll?WCMS:STANDARD::pc=PC_100374*