Using drones for the detection of crop pest damage in canola

MEGAN BEVERIDGE[1] AND ALEX RUSSELL[2]

[1] Southern Farming Systems (SFS)
[2]Production, Environment and Quality (PEAQ) Management

KEY MESSAGES

- Slugs are a major pest for emerging canola crops in the high rainfall zone (HRZ)
- Detection across large areas is difficult from the ground
- Remote plant counts can be produced using images collected by drones
- Information can be returned to the grower within five days
- Only two out of every five days had suitable flying conditions, causing image collection to be delayed.

BACKGROUND

Slugs are a major pest for emerging canola crops, causing significant damage in the HRZ of Victoria. The costs associated with slug damage are significant, having an impact not only to the crop subjected to the initial damage but to successive crops in the farming system. This includes costs and impacts associated with re-sowing, baiting, burning of stubble, cultivation and reduced area sown to canola (Midwood 2013).

Growers, agronomists and advisors do not have an effective strategy that will consistently control slugs, instead relying on reactive control measures after damage has occurred. The most common slug control strategies used by growers include burning of stubble, cultivation, rolling and baiting post-sowing. The reactive nature of control measures requires extensive monitoring of slug populations and crop damage.

The timeframe for making critical interventions and/or re-sowing decisions in canola is narrow and based on manual observation, taking into account the number and condition of plants as well as the evenness of established plants. Currently, these decisions are limited by the ability to identify establishment issues across large areas. Neil Hives noted that the patchy nature of early plant damage caused by initial pest infestations is currently hard to detect by growers and agronomists from the ground.

The application of drones or unmanned aerial vehicle (UAV) platforms to collect timely imagery for use in agriculture is becoming increasingly viable. Preliminary research, undertaken as part of the application process, identified the opportunity for developing the use of UAV imagery applications in crop pest management (Zhang 2012).

SFS identified the potential for utilising UAVs to estimate slug damage over large areas as a significant opportunity to improve crop production in the HRZ. The potential of UAVs to detect early plant damage will allow for targeted control of pest problems. This provides the added benefit of maintaining integrated pest management (IPM) practices.

PROJECT AIMS

The aim of this project is to investigate the feasibility of utilising image data, collected using UAVs, to make timely management decisions relating to slug damage in emerging canola.

Three trail sites were established in the HRZ of western Victoria. Site selection was based on grower estimates of slug pressure at the site leading up to the canola growing season in 2015. The following treatments, based on advice from IPM consultant Neil Hives, were included at each of the three sites.

- Nil treatment – no slug baits applied.
- Grower treatment – slug baiting as per grower rate.
- Managed treatment - slug baiting as per advice from Neil Hives.

Images were collected three times throughout crop establishment and once prior to the crop emerging. These images were then transferred to Luminis Analytics in Perth for spectral analysis, producing a count of emerging plants across the entire paddock.

Image collection

Image collection was undertaken by Martin Peters of FarmingIT using an UX5 platform (UAV), produced by Trimble. Flights were undertaken at each of the sites during cotyledon, two-leaf and early flowering, as well as once prior to sowing.

Until the final round of flights there were no interruptions to the flight schedule due to adverse weather conditions. At this point, flights were delayed by four weeks due to weather conditions and availability of the UAV.

The two main factors that hinder the ability to collect images using UAVs are wind and rain. Using the Bureau of Meteorology data from the Colac weather station, we considered the number of days that weather conditions would likely affect the ability to fly UAVs during the sowing window (April and May).

Trimble advises 65 km/h winds and 'light rain' as limits for flying the UX5 platform. During April 2015, the Colac station observed 4 days with wind above 65 km/h in April and 12 days in May. We were not able to classify rain events as light or otherwise, and therefore could only report on the number of days that rainfall occurred in April and May of 2015 – 15 and 18 days respectively.

This resulted in 15 days in April and 20 days in May where flying conditions were likely to be unsuitable, causing image collection to be delayed.

A further consideration for the suitability of the weather for collecting images is cloud cover. While both cloud cover and full sun conditions produce suitable images, partly cloudy or changing conditions over the duration of the flight affect image quality and normalised difference vegetation index (NDVI) readings.

Data transfer

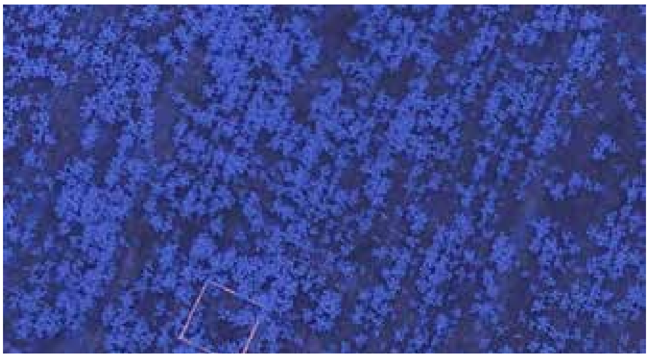
The images collected contained approximately 30 GB of data per flight, giving a total of 90 GB over three sites which needed to be transferred between Meredith and Perth. As part of the project we needed to understand the timeframe in which we could transfer large amounts of data.

The two methods of transfer available to us were internet and postal transfer. At the time of testing postal transfer was approximately five times as quick as internet transfer and ensured the turnaround of information was within five days.

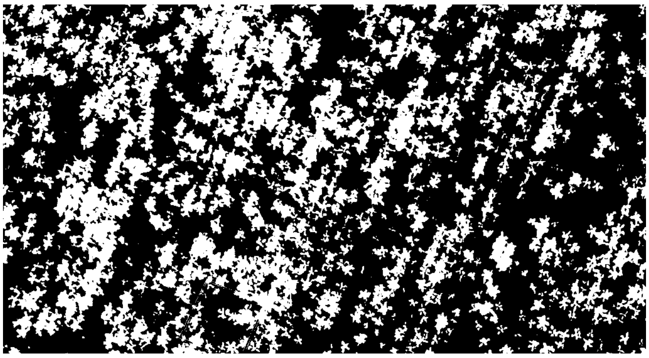
Spectral analysis

Alberto Dri of Luminis Analytics conducted the 'spectral analysis' to produce plant counts and ground cover proportions. This involved building an algorithm that used colour, texture and shape as parameters for differentiating between canola plants and bare earth and weeds.

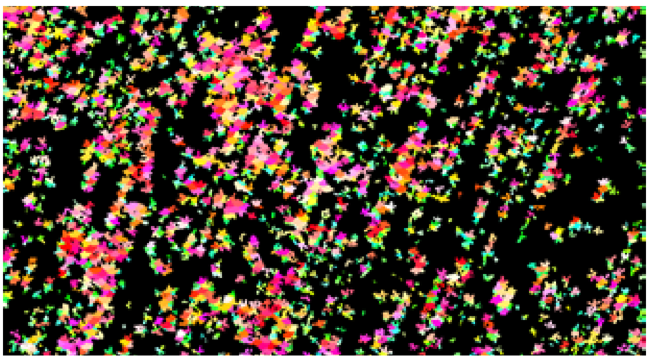
a. Start with a CIR (colour infrared) images.



b. Use colour, texture and shape to create a binary image.



c. Put the two together and find the totals



d. Calculate ground cover and print legend

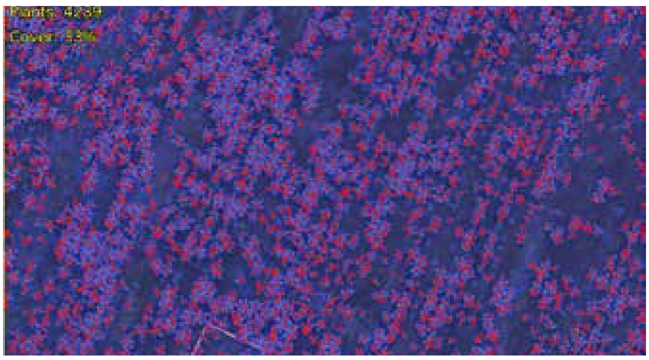


Figure 1 (a, b, c and d). Colour infrared images of the crop were manipulated in order to conduct plant counts.

Unfortunately, given the timing of flights, optimal image collection for counting individual plants did not occur at all sites. As a result, we had to make some assumptions about the number of plants present when full ground cover occurred. For this we relied on manual plant counts to advise the number of plants when individual plants could not be identified – this is termed latticing.

RESULTS

The dry conditions encountered in Victoria leading up to sowing and throughout establishment meant that the impact of slugs was negligible and little difference between the treatments was detected. However, we were able to learn a great deal about the practicalities of image collection and turnaround of information for management decisions.

With consideration given to all aspects of image collection, transfer and analysis, the project was aiming at and achieved a five-day turnaround of information – from the time of flights and image collection to useful data being returned to the grower.

Information returned to the grower will take the form of a contour map allowing for consideration of the plant counts, ground cover and evenness of distribution. This allows for the possibility of utilising this information in variable rate technology.

ACKNOWLEDGEMENTS

This project was a joint collaboration between SFS and PEAQ Management, funded by GRDC Research Code SFS00030. Thanks to Martin and Jo Peters of FarmingIT, Alberto Dri of Luminis Analytics and Neil Hives of IPM Technologies for their involvement in the project. Thanks also to the farmers who hosted trials on their properties.

REFERENCES

Midwood J (2013) Evaluation of management strategies to effectively control slugs in the High Rainfall Zone cropping region, In ‘Trial Results Victoria Edition 2013’. pp. 1–14 (Southern Farming Systems).

Zhang C, and Kovacs, JM (2012) The application of small unmanned aerial systems for precision agriculture: a review. Precision Agriculture, 13, 693–712.