Monitoring barley grass in broad acre paddocks

RESEARCH

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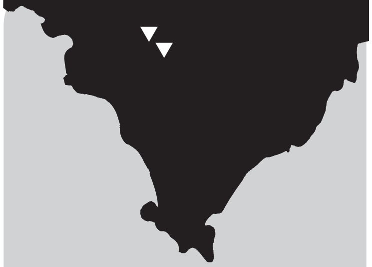
Searching for answers



Location
Minnipa Agricultural Centre
Rainfall
Av. Annual: 325 mm
Av. GSR: 241 mm
2017 Total: 281 mm
2017 GSR: 155 mm
Soil Type
Red loam
Plot Size
Paddock monitoring

Location
Yaninee
Rainfall
2017 Total: 274 mm
2017 GSR: 126 mm
Paddock History
2017: Medic pasture spray topped
2016: Grass free medic pasture
2015: Mace wheat

Key message

- **UAV imagery with appropriate analysis has the potential to identify weed issues in paddocks quickly, reliably and cheaply over large areas.**

Why do the trial?

Barley grass continues to be a major grass weed in cereal cropping regions on upper Eyre Peninsula (EP). The use of unmanned aerial vehicle (UAV) technology to identify and assess barley grass populations in paddocks and monitor potential resistant populations may be a useful tool for farmers. Barley grass weed density was monitored in three paddocks on upper EP (Minnipa Agricultural Centre (MAC), Heddle's at Minnipa and Wilkins' at Yaninee) using a UAV during the 2017 growing season at three different timings, with paddock transects conducted to verify grass weed density in paddocks.

How was it done?

In-crop paddock monitoring for grass weed populations

Grass weeds were assessed in-crop or in pasture at ten GPS points along a transect for crop or weed density, with six counts taken at each sample point. This was used to verify the UAV data captured at three times during the cropping season. Extra sampling points in the paddock were targeted if more information was needed to verify the imagery. The paddock photos were captured on an iPad with 'Avenza Maps' linked to the location in the paddock.

UAV imagery

UAV data was captured during the 2017 cropping season on 14 August, 28 September and 3 October. The UAVs used were either a DJI Matrice 100 with both NIR and RGB sensors or a Mavic Pro with RGB sensors. The UAVs were flown at a height of 118 metres.

Data analysis of UAV imagery

To analyse weed locations at a whole paddock level using the UAV imagery, geospatial analysis tools were used to automate the selection of likely weed infestation areas. A map of the paddock with the UAV coverage was generated from ArcGIS Desktop as a geo-pdf to enable collection and analysis of field data. This is a map file which can be used in a range of devices. With this file loaded to the 'Avenza Maps' app on a tablet, photos and comments with GPS locations were collected. This data was then added to ArcGIS and used to interpret the UAV mapping.

The Spatial Analyst extension within ESRI's ArcGIS Desktop software was used to carry out a 'Maximum Likelihood' spatial classification. This classification uses small parts of the image selected by the user as 'training features' for deciding which category each pixel of the image most likely fits into. This classification method is based entirely on the spectral (colours through different bands of light) characteristics of the imagery. Training features were created which highlighted areas of; high weeds, low weeds/crop features, and bare ground (example photos are shown in Figure 2). The training features selected within the crop were mostly inter-row areas when selecting high weeds, and mostly crop rows when matching to less weeds.

What happened?

Originally, we had planned to undertake monitoring in cereal paddocks, but due to the late start and poor opening rains on upper EP in 2017, two of the paddocks to be monitored (Minnipa and Yaninee) changed rotation from cereal to pasture. The MAC paddock monitored was MAC S4 which was sown to barley.

On upper EP the 2017 growing season rainfall was a decile 1 (well below average), with the first substantial rainfall event not until early July in cold conditions. The first flight time was 14 August, with crops only at the four leaf stage and lower than expected grass weed germination. Low plant tillering and continued dry seasonal conditions resulted in a very poor season. The UAV data captured was later than anticipated due to the late start and poor seasonal conditions.

The pasture paddocks (predominantly medics) were still monitored with the UAV to capture grass weed density and location in the paddock. These paddocks will be measured in the 2018 season in cereal crops. One paddock had suspected resistance to Group A herbicides as the grass weed patches were circular and spreading, and this was confirmed with herbicide resistance testing during the season. This paddock will provide an opportunity to see if UAV technology is an accurate monitoring tool for on-farm grass weeds.

Issues with classification

It was harder to detect areas high in barley grass numbers in the barley crop (Figure 1) than anticipated as the photos showed that a large percentage of the weeds were within the crop rows. It would be easier to define patches of grass weeds if they were mostly located in the inter-row. Study of the photos taken on site along with the matching UAV imagery provided better information for selecting training areas (Figure 2) to interpret the grass weed density.

Pasture areas provided much clearer weed signatures for training data analysis, especially earlier in the season. The pasture sites varied during the season with the amount and intensity of grazing. The Heddle's site was more intensively grazed which changed the appearance of grass weeds in the UAV imagery. Wilkins' paddock contained more obvious barley grass patches with intact seed heads. Training examples from the paddocks are shown in Figure 2.

What does this mean?

UAV imagery may provide an opportunity to assist in targeted grass weed management. Current UAV technology is cheap, high resolution and quickly available for management decisions compared to other potential image sources, such as high resolution satellite. However the advantages must be balanced against the time and effort of collecting data over large areas, analysing the data and the variable image quality. To improve feature recognition, it would be worth trying UAV flights over a representative strip at half the usual height to provide a higher resolution strip which could be used in analysis.

As UAV technology improves with higher resolution data capture, other analysis techniques could also be explored, such as those based on shape recognition. The major attraction for this method of analysis is the short time taken to highlight representative image samples and if the samples could be used across multiple images (of other paddocks) this would make the technique even more efficient.

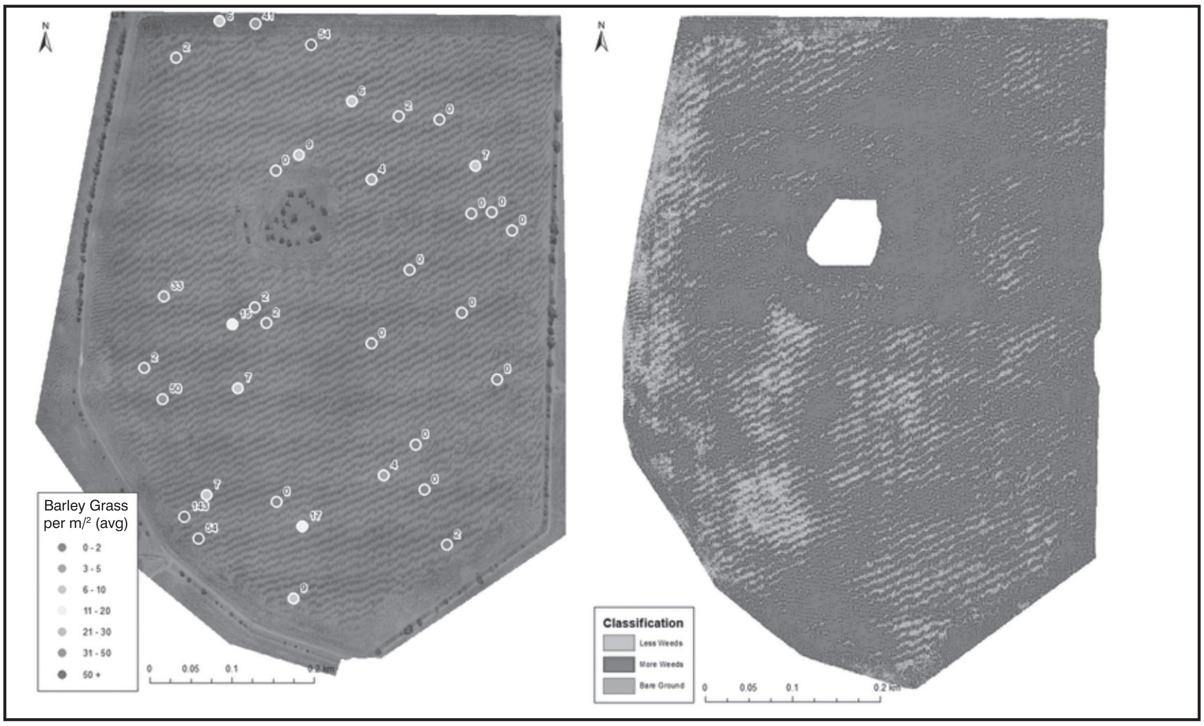
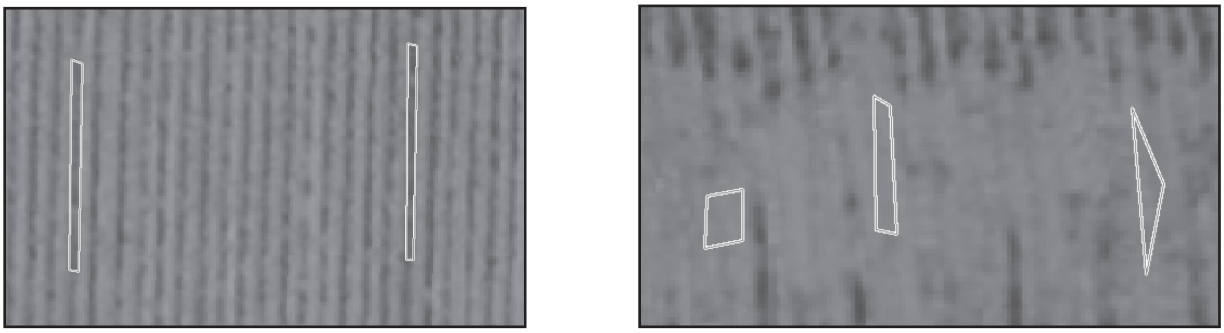
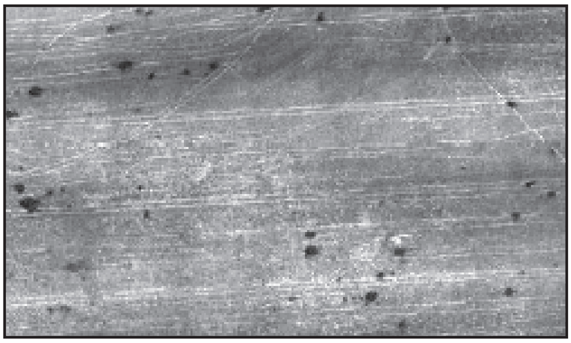


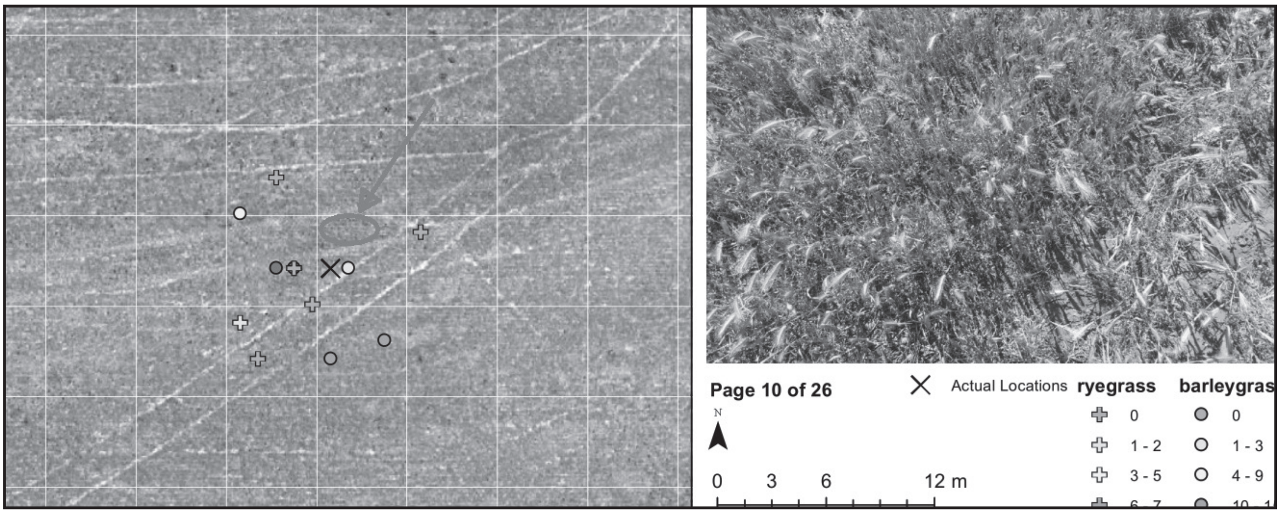
Figure 1. Maps of Minnipa S4 (barley), (left) on ground sampling points and barley grass density, (right) weed density map from UAV in 2017.



MAC S4 paddock - Low weeds with crop (above left) and bare ground (above right)



Pasture – High grass weed density areas (above) visible early in the season



Pasture - Initial data map-book page showing the location of barley grass within the UAV imagery by combining information from the photo and imagery.

Figure 2. Examples of training features.

This research is ongoing for the next two seasons so more information and knowledge will be generated about the use of imagery and data collection for weed management in current farming systems.

Acknowledgements

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