

## CAWS Student Travel Grant Report

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With the support of the CAWS Student Travel Award I was fortunate to attend the much anticipated 22<sup>nd</sup> Australasian Weeds Conference in Adelaide, South Australia. The conference took place at Adelaide Oval from the 25<sup>th</sup> to 29<sup>th</sup> September 2022, showcasing the breadth of research and development occurring in weeds research in both environmental and agricultural systems. Over the four days of presentations and workshops, the conference attracted around 250 people from predominantly Australian and New Zealand industry, government and research institutions to discuss challenges facing weed control in different production and environmental systems.

The combination of both environmental and cropping weeds research was one of the strengths of the conference, providing an opportunity to hear from and meet people using similar methods for different purposes. I particularly enjoyed learning more about the role of social science in weed science from Dr Sonia Graham and the University of Wollongong, who described the different forms of collective action in weed control and how different disciplines contributed to the better management of weeds. On the technology front, a presentation by Dr Mostafa Rahimiazghadi from James Cook University, provided more details on the performance of deep learning-based weed recognition in sugar cane systems. A great discussion on data requirements and reducing herbicide run off in the Great Barrier Reef catchment followed.

There was also an opportunity to join the Weed Remote Sensing Community of Practice and learn from other researchers and industry professionals in the field about their experiences with weed recognition technology. The session sought to better identify barriers to development and opportunities for better collaboration and focus for researchers in this field. Participating in this discussion and learning about other approaches to problems was insightful.

I presented on two aspects of my research, with a talk on laser weeding and poster on open-source weed detection technology, known as the OpenWeedLocator. There were some good questions from the audience on the role of laser weeding in large-scale Australian production systems, and further discussions were had after the presentation about where laser weeding and weed recognition may move next.

Following the conference, I arranged to meet with researchers at the Australian Plant Phenomics Facility (APPF) at the University of Adelaide, Waite Campus. The APPF is a cutting edge, robotic plant phenotyping facility with controlled glasshouse and field phenotyping systems. There I saw robotic glasshouses, controlled environment facilities and field

**OpenWeedLocator (OWL): community driven weed detection**

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**Background**

- Site specific weed control (SSWC) targets individual weeds instead of blanket application.
- Reliant on reliable, rapid weed recognition.
- Sensor based approaches have seen rapid savings of up to 90% but are often inaccessible.
- Need for low-cost, accessible, educational tool for image-based weed detection.

**Objective**

- Develop a low-cost, open-source image based fallow weed detection system.
- Evaluate efficacy in variable fallow field conditions.

**Methodology**

- System developed with software and hardware modularity using off the shelf components (Raspberry Pi).
- Four colour based, open source algorithms selected combining excess greens and NDVI (see methodology (Figure 2)).
- Validated on seven different transects in dry and wet.

**Results**

**Performance**

- Algorithms performed similarly across 66 transects.
- Mean precision of 79%, recall of 52% across all algorithms & fields (Figure 3).
- 52% precision and 74% recall recorded across a single transect.
- Small weeds and non-green weeds missed (Figure 3).
- Variable performance highlights limitations of colour-only algorithms.

**Engagement**

- Devices confirmed to be built in Australia, US, UK, France and Canada.
- Community engagement through GitHub.
- Enclosure redesigns - OWL released soon.
- New software provides > 20% boost in recall.

**Conclusion**

- Low-cost, image-based weed detection is possible with advances in computer hardware and software performance.
- The OWL provides an educational opportunity for new weed detection technology.
- An open-source, modularity approach enables community driven development and accessibility for applied and scientific.

**Figure 1** An essential original version of the OpenWeedLocator (OWL) with the Raspberry Pi 4, 8GB RAM, 64GB SSD, 12V power bank, 12V USB-C power bank, 12V USB-C power bank, 12V USB-C power bank.

**Figure 2** The image processing pipeline for green-based weed detection. The color image is split into four color channels (red, green, blue, and near-infrared) and processed by four different algorithms (excess greens, NDVI, and two color-based algorithms) to produce a binary mask. The final mask is the result of a logical AND operation between the four binary masks.

**Figure 3** Comparison of precision and recall for the four different algorithms across seven transects. The x-axis represents the transect number and the y-axis represents the percentage of weeds detected. The legend indicates the four algorithms: Excess Greens (EG), NDVI, and two color-based algorithms (C1 and C2).

**Figure 4** Comparison of precision and recall for the four different algorithms across seven transects. The x-axis represents the transect number and the y-axis represents the percentage of weeds detected. The legend indicates the four algorithms: Excess Greens (EG), NDVI, and two color-based algorithms (C1 and C2).

**Want to find out more?**  
Scan to explore the full GitHub repository

THE UNIVERSITY OF SYDNEY

My poster from the conference on the OpenWeedLocator.



**The robotic phenotyping greenhouse at the Australian Plant Phenomics Facility (APPF). The system automatically images, waters, and moves the pots.**

phenotyping equipment too. It was fantastic to discuss plant imaging and phenotyping and learn more about how they assist plant research in Australia.

Many thanks to CAWS for supporting this trip to the 22AWC in Adelaide. The opportunity to present my research and meet with other weeds science researchers was invaluable.