Project Summary

Site-specific weed control for ginger cropping systems

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Weeds pose the largest threat to crop yields globally. If left uncontrolled in ginger, weeds could result in yield losses greater than 80%. Given the intensive, high input nature of ginger production systems this level of yield loss can be devastating to production and profitability.

In ginger, the four to five month window between sowing and canopy closure is the critical weed-free period. Once the canopy has closed weed growth is hindered by shading and strong crop competition, reducing the production risk of weeds. Consequently, weed control during this critical weed-free period is essential in preventing damaging weed infestations and yield loss.

Current control methods rely on the individual or combined use of selective pre-emergent herbicides or non-selective post emergent spot spraying or hand pulling treatments. The early season, post-emergent weed control treatments are labour intensive, risk significant crop damage, and are extremely costly. Estimated yearly labour costs for weeding alone are approximately $3000 – 5000 per hectare. The current high costs of weed control are a major constraint to the area of ginger production in Australia.

While weeds pose a significant threat, developments in cameras, sensors and computer processing power has created an opportunity to use artificial intelligence and robotics for weed control. Once the weed has been detected, site-specific control with herbicides or even blue-sky alternatives, can then be implemented with precise robotic delivery mechanisms mounted on autonomous platforms.

Objective

The project aims to improve weed control for ginger growers, using artificial intelligence for weed detection, precision herbicide delivery and an evaluation of alternative weed control opportunities.

Overview

The project will approach the challenge of site-specific weed control through three parts:

1. Weed detection and recognition

2. Site-specific delivery

3. Investigation of alternative control technologies

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The detection of weeds using machine learning algorithms requires thousands of training images to develop a consistent and accurate detection rate. Just like training weed scientists requires extensive study and diverse observations of a range of weeds in different environments, machine learning algorithms also need diversity in training. Images for the dataset will be collected during the four-month critical weed-free period from growers across the ginger growing region.

This method will help capture differences in soil surface, sunlight, shadows and plant characteristics. Once collected the images will be used to develop and compare performance of different machine learning detection algorithms, ensuring optimum accuracy and repeatability. These algorithms will continue to be refined with the addition of more images throughout the three-year project.

Once a weed has been identified and located, the control option (either herbicide or an alternative control) needs to be selectively applied directly to the weed.

Part 2 of the project will design and test an effective delivery mechanism for weed control treatments. A range of site-specific delivery options will be evaluated including a delta arm, three-axis gantry system and a robotic arm. Subsequently, a full scale, test-stand mounted unit will be evaluated for weed control effectiveness. Parts 1 and 2 of the project will be integrated on a commercially available autonomous platform for field tests.

Part 3 of the project investigates alternative methods for weed control in ginger (e.g. lasers and electrical weeding). The aim of these preliminary evaluations is to define alternate weed control technologies suitable for autonomous, site-specific use in ginger production systems

Implications

The consistent detection and identification of weeds creates the opportunity for site-specific weed control using alternate technologies in ginger cropping systems. Weed species recognition and localisation allows targeted control, reducing the reliance on costly manual weeding and spot-spraying. Furthermore, site-specific management allows for the implementation of alternative control technologies such as lasers, electrical weeding and other mechanical methods, significantly reducing the use of herbicides. Similarly, the cost reduction means ginger growers have opportunities to expand production, without the risk of weed infestation related production risks. The implications for this technology in ginger are exciting, with significant potential for other row crop industries.

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