Charles Sturt University

Gulbali Institute

Agriculture Water Environment

Gulbali PhD scholarship prospectus 2025

Challenge Project: Novel Weed Control Approaches in grain production systems.

Charles Sturt University

Who we are

Charles Sturt University is Australia's leading regional university – with a global perspective.

Our history of innovation and educational empowerment reaches back as far as 1895 with the establishment of the Bathurst Experimental Farm. That was the first step in connecting people, communities and industry to make a real difference. Professionally. Socially. Economically.

Formally incorporated in 1989, we are Australia's largest regional university. We have campuses across New South Wales, and teaching partnerships in Canberra, Goulburn and Wangaratta.

We also have diverse international partnerships and provide online education nationally and across the globe.

Our university is grounded in the qualities we draw from our regional roots – our sense of community, our will for hard work, and our resilience when times get tough. We have turned the challenge of connecting multiple campuses across hundreds of kilometres into an opportunity – to apply the lessons we have learned to connect students across Australia and the world.

Our student body – numbering some 43,500 – stretches from the banks of the Murrumbidgee River to the oceans in Port Macquarie. And our alumni – 220,000 strong and counting – are applying their learning everywhere too, from the red centre and the white wilds of Antarctica, to the heart of the world's megacities.

And that's not just the case for our students. We have research and industry partnerships that reach across the nation and around the globe – sharing knowledge, driving change, fostering growth.

Yindyamarra winhanganha

It means the wisdom of respectfully knowing how to live well in a world worth living in. And it's what we strive for. Every day. How? By making connections.

Connecting our students with the knowledge and wisdom to shape the world and reach their potential.

Connecting our research to real-world issues.

Connecting new technologies with traditional wisdom to protect ecosystems and forge a more sustainable future.

And connecting people, industry and government to share ideas, build knowledge and find innovative solutions to today's – and tomorrow's – challenges.

Our vision

Our vision as Australia's leading regional university, is to advance the careers of our students, inspire research excellence and drive regional outcomes with global impact.

We seek to empower the leaders of tomorrow through innovative education and applied research, and we have a strong commitment to learning from and working with Australia's First Nations Peoples.

It's why we are committed to the transformative University Strategy 2030. It's our commitment to our communities. To our partners. To our students. To our regions. A long-term strategy deepens our relationships, enabling us to build a stronger tomorrow together.

Students	Research	People	Social responsibility
We connect our students with the knowledge and wisdom to shape the world	We collaborate with our partners on research with impact	We are capable, inspired and empowered to deliver excellence	We engage regionally and globally to drive sustainable prosperity

Studying in Australia

An experience like no other

At Charles Sturt, we're geographically gifted. We have five campuses across regional Australia in Albury-Wodonga, Bathurst, Wagga Wagga, Orange and Port Macquarie.

Our campuses are safe, close-knit communities. Your lectures, tutorials, practical workshops, cafés, gym and the all-important library, are just a short walk from one another.

Our PhD Supervisors have small student cohort sizes which means targeted and specialised tuition.

At Charles Sturt, we have a strong student community. You'll study alongside students from across the country and the world - 24% of our students are international students from 113 countries - making lifelong friends along the way.

Gulbali Institute

Agriculture, Water and Environmental Research

We acknowledge and pay respect to our Wiradjuri First Nations people by using their native language in the naming of this research institute.

"Gulbali ngurambang" is Wiradjuri which translates to "to understand country". After consultation with First Nations people, we use this phrase respectfully as the name of our research institute.

The Gulbali Institute creates impactful integrated agriculture, water and environment research, grounded in Charles Sturt's footprint across the Murray-Darling Basin, but with impact across Australia and globally.

We emphasize return on investment to increase productivity for farmers, improve natural environments, and reduce risk in agricultural and environmental management.

The Gulbali Institute will maintain Charles Sturt's existing research program and its strong relationships, particularly with Research Development Corporations, key State and Commonwealth departments and agencies, and private industry to achieve outstanding outcomes.

The Institute will undertake multi- and interdisciplinary research and innovation, focusing on large scale programs in the field of:

- Biosecurity
- Agricultural Innovation,
- New Food and Beverages,
- Sustainable Aquatic Systems
- Cultural Connection and Environmental stewardship

Find out more

→ https://www.csu.edu.au/research/gulbali

The Gulbali PhD program

Details and rationale

The Gulbali PhD program is a range of prestigious scholarships for both domestic and international research candidates. In most cases, these scholarships are available to Australian or New Zealand citizens or Australian permanent residents. We are seeking highly talented researchers who are global thinkers, seeking to address grand challenges, which align with the key Gulbali research institute focal areas.

Selection Criteria

a) Previous Academic Performance: This assessment considers the level of the applicant's highest, relevant, qualification in line with CSU entry requirements for PhD courses (See note** on Page 6).

b) Research and/or Professional Experience: Evidence of an applicant's research achievements and relevant professional experience. This includes such aspects as peer-reviewed research outputs, high esteem academic awards and prizes, relevant research and/or professional experience.

c) Research Alignment and Supervisor Capacity at Charles Sturt: Alignment with both CSU and/or industry strategic research priorities and strengths. This includes the strength of alignment with the Charles Sturt 2030 Research strategy: the supervisory capacity, FoR alignment with Coaldrake, and the expected impact and end user engagement of the proposed research.

d) Degree of support from Gulbali projects, teams and/or supervisors.

e) Research Question and proposed methodology.

Who is eligible?

- Prospective PhD students interested in joining Gulbali projects and/or teams and/or propose a project with a strategic link to the Gulbali institute mission/objectives
- High quality international and domestic students meeting minimum requirements for Charles Sturt University
- Students considering entry into a PhD program into session 2 2025.

How to apply?

Gulbali will run a two-stage EOI process which will be advertised on the Charles Sturt University scholarships page and through national media.

The first stage will require applicants to complete an online form and submit, along with a professional CV and transcripts.

Candidates will then be shortlisted and top applicants, and supervisors, will be invited to complete the Charles Sturt admissions process.

Closing date for EOIs is **8th February 2025.**

Shortlisting will take place in **late February 2025**, with highly ranked students invited to submit enrolment applications by **2 March 2025.**

Key Details

Commencement:
Students must commence in **Session 2 2025.**

Study load:
Only full-time applicants will be accepted for shortlisting.

Stipend:
This scholarship is valued at $35,000 per annum, payable in fortnightly instalments. First Nations applicants will have a stipend valued at $50,000 per annum.

Top Ups:
Various industry and university top ups of up to $10,000 per year are available, by application, following acceptance of enrolment. The principal Supervisor will advise eligibility.

Tuition Fees:
Domestic candidates: Fee exemption for a period equivalent to four years (eight sessions) for PhD at full-time study.

International candidates: Fee exemption for a period equivalent to three years (six sessions) for PhD at full-time study.

Operating Funds:
Scholarship candidates are allocated an allowance to assist with the reimbursement of costs associated with a candidate's research. The annual amount reflects whether the project is linked to specific field or education codes, lab-based, non-lab-based and/or First-Nations focused.

Selection:
A weighting system will be established to rank candidates. Shortlisting will take place by an expert committee of research active academics.

Visa:
International students will require a valid student visa and insurance to commence. Processing can take up to 4 months. Limited relocation funds (up to $5,000) are available.

English language proficiency:
Shortlisted International students must upload evidence of English language proficiency, as part of the enrolment process, in line with any of the following minimum CSU standards:

1. Providing evidence of having completed a sufficient standard of study in English.

2. Having obtained an Academic IELTS (or equivalent) within the last 2 years with a minimum overall score of 6.5 and no individual score below 6.0

3. Written evidence of a degree that was conducted and examined solely in English.

4. Level 109 of the ELS examination with a score above B (reading and writing) and above P (speaking and listening) in the last 12 months

5. Applicants can request (in writing) that alternative evidence be considered. These are individually decided by the Pro Vice Chancellor (Research and Innovation).

Charles Sturt University Doctor of Philosophy entry requirements:

**Note on CSU Doctor of Philosophy entry eligibility:

Applicants must have achieved at least one of the following:

a. Qualified for the award of a master by research with an acceptable level of performance.

b. Completed a bachelor degree followed by a one-year honours degree with class 1 or class 2(1) honours, specialising in the same discipline or a closely similar discipline.

c. Gained class 1 or class 2(1) honours in a bachelor degree of at least four years full-time duration, specialising in the same discipline or a closely similar discipline.

d. Commenced a masters by research at the University and shown exceptional ability in a research project that is clearly capable of being extended to a doctoral level.

e. Qualified for the award of a coursework masters:

    i.   including a research component subject or research component subjects totalling at least 16 Charles Sturt University points, or equivalent; and

    ii. normally with a grade average equivalent at class 2(1) honours or better.

f. Completed another appropriate combination of undergraduate and postgraduate qualifications (such as relevant graduate diplomas) and research experience that demonstrates capacity for research at a doctoral level.

Critical dates

Dates are fixed and tied around the need to allow sufficient time for proposals, assessments, enrolment, screening, and (if applicable) visa applications.

The timeline below is targeting census date 2025 teaching session two.

- By 20th December 2024: Call of EOI's opens.
- By 8th February: EOI's due to be submitted to challenge program lead.
- By 28th February: Challenge program lead submits three preferred students to Gulbali.
- By Thu 2nd March: Gulbali Leadership team review recommended candidates.
- By Fri 3rd March. Challenge program lead makes verbal offer to students.
- By 15th March. CSU issues written offer and student accepts.
- By 31st March. Student submits Visa application (if applicable).
- By 8th August. Student commences in second session.

Challenge Project Summary

Project Summary

Research activities are focussed on addressing the question of "What are the opportunities and requirements that ensure the effective and ongoing use of novel weed control technologies in grain production systems" that provide sustainable crop protection and food security. The challenge of diminishing weed control will be addressed through the three linked PhD projects:

PhD project 1: Development of novel weed control technologies suited for use in grain production. Research activities will identify novel weed control treatments that control major weed species (e.g. annual ryegrass, brome grass, wild oats and wild radish) of cropping systems. The influence of environmental factors (e.g. soil moisture, temperature, humidity) and treatment application methods (e.g. growing point vs whole plant) on efficacy will also be determined.

PhD project 2: Identify the period available for the deployment of novel weed control technologies. Research will identify the effective weed control period as influenced by varying production environments. Collected information will allow the development of predictive decision support tools that identify weed control opportunities according to expected environmental conditions.

PhD project 3: Characterising and mitigating the threat of weed adaptation to weed recognition systems. The potential adaptation in weed plants/species to avoid weed recognition and therefore, control with site-specific treatments will be determined. Evidence will be collected on variations in morphological traits that occur in weed plants exposed to weed recognition selection. Changes in weed recognition algorithm detection accuracy on successive generations of selected weed populations will identify any progression towards adaptation (resistance) to weed recognition.

Collectively these linked and interacting projects will focus on developing novel weed control technologies, identifying their use case, and ensuring their ongoing efficacy prevent the loss of weed control resources. Due to the loss of herbicides the productivity and sustainability of the Australian grain production systems is threatened. Across the 25M ha annual grain production area herbicide use is essential to preventing weed interference with crop growth and preserving grain yield and quality.

Project outcomes and outputs

Characterising the opportunities and requirements that ensure the effective and ongoing use of novel weed control technologies in grain production systems will identify effective and resilient approaches to the use of precision weed control technologies for grain production systems.

i) **Which novel weed control technologies are most suited for use in Australian grain production systems?** The outcomes from this research will focus development and drive the commercialisation of these systems. Project activities will facilitate the introduction of alternative nonchemical weed control option for grain production.

ii) **How much time is there for late-season weed control to prevent viable seed production of in-crop weeds surviving early post-emergence treatments?** Identifying the appropriate timing the approaches to delivery of novel weed control treatments the introduction of these technologies will be streamlined and efficient.

iii) **Are combinations of weed recognition technologies needed to prevent adaptation to avoid weed detection?** Accurate weed recognition and subsequent effective control represents a high-level selection intensity that will drive adaptation towards resistance to the effective use of this technology. With these adaptive processes identified, strategies that reduce/prevent adaptation can be developed and then tested to ensure enduring weed recognition (and control) capability.

The conduct and completion of the linked PhD research programs will provide industry guidance and knowledge for the sustainable use of site-specific weed control technologies in Australian grain production. Achieving the goals of the three proposed PhD research projects will create the enduring ability to specifically control identified problematic weeds with novel weed control technologies. This research output enables enhanced crop protection capability by providing low-cost sustainable weed control techniques.

PhD Project: 01

Research Question

Which novel weed control technologies are most suited for use in Australian grain production systems?
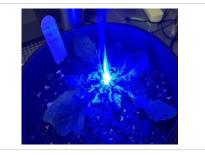
Principal supervisor

Professor Michael Walsh

Faculty/institute

Gulbali Institute

Proposed campus

Wagga Wagga

PhD project abstract

A range of alternative weed control options are needed to diversify and sustain weed management programs as well as to mitigate/prevent the evolution of resistance to weed control tactics (chemical and non-chemical). Preliminary evaluations and reviews have identified a range of techniques that are suitable for use as site-specific weed control treatments in grain production systems. These include lasers, electrical weeding, waterjet cutting, directed energy (blue light + mid-wave infrared radiation) and inter-row mowing. To develop commercial interest in these technologies the weed control capability in the Australian grains context needs to be clearly identified. Technology specific research and development will be undertaken to identify weed control efficacy, appropriate delivery timing/s and suitability for use in grain production systems.

Preferred candidate experience, skills and knowledge

Understanding of the principles involved in the design and conduct of glasshouse studies.

Expertise in data collection, analysis and interpretation.

An understanding of Australian grain production systems and weed control needs

Campus location and place of work

Wagga Wagga campus, glasshouses, field areas and agronomy lab

University of Western Australia, Centre for Engineering Innovation

Texas A&M for lab studies on Directed Energy system

Direct enquiries to

Professor Michael Walsh, E: michwalsh@csu.edu.au, M: 0448 847 272

PhD Project: 02

Research Question

What time is available for late-season in-crop site-specific weed control with novel control technologies?

Principal supervisor

Professor Michael Walsh

Faculty/institute

Gulbali Institute

Proposed campus

Wagga Wagga

PhD project abstract

With the development and introduction of site-specific weed control capability and autonomous systems there is the potential for continuous and precision targeting of weeds that have survived initial herbicide treatments. In-crop weed control is focussed on the early post-emergence phase when it is most critical to remove weed interference to preserve yield potential. After this period established crops are mostly resistant to weed competition and therefore, the focus of weed control is switched to preventing viable seed production and future weed problems. In these situations, autonomous weed control platforms can be used to target the frequently low density (<1.0 plants / 10m^{-2}) weed populations that survive initial weed control applications, potentially due to herbicide resistance. The effective development and use of these systems is reliant on an understanding of the weed control opportunity and in particular the time available for effective weed control delivery between identified survival and the viable seed production.

Preferred candidate experience, skills and knowledge

Capability and understanding in the conduct of field research.

Understanding of the principles involved in the design and conduct of glasshouse studies.

Expertise in data collection, analysis and interpretation.

An understanding of Australian grain production systems.

Campus location and place of work

Wagga Wagga campus, glasshouses, field areas and agronomy lab

University of Western Australia for WA field data collection

University of Adelaide for SA field data collection

University of Queensland for field data collection

Direct enquiries to

Professor Michael Walsh, E: michwalsh@csu.edu.au, M: 0448 847 272

PhD Project: 03

Research Question

Can combinations of weed recognition technologies prevent adaptation to avoid weed detection?

Principal Supervisor

Professor Michael Walsh

Faculty/Institute

Gulbali Institute

Proposed campus

Wagga Wagga

PhD project abstract

Weed detection technologies will be compared for their ability to select for weed biotypes adapted to avoid detection via crop mimicry. Recognition algorithms will be developed from images of crop (wheat and canola) and weed (annual ryegrass and wild radish) plants collected using single and multiple devices. The developed algorithms will be used in a selection process on pot grown weed populations. This involves detected plants (i.e. >90% accuracy) assumed as potentially controlled and discarded. Plants less accurately detected (i.e. < 50% accuracy) will be assumed survivors and will be retained for regeneration. This process will be repeated over generations with the progeny of unselected populations compared for their morphological similarity to the crop species. These studies will identify the technology stacks that are required to prevent the evolution of weed avoidance (adaptation) to the use of weed recognition.

Preferred candidate experience, skills and knowledge

Expertise in the design and conduct of research trials.

Strong background in crop agronomy and weed management

Understanding of weed control practices in crop production systems

Understanding of weed recognition systems desirable but not essential

Campus location and place of work

Wagga Wagga campus, glasshouses, field areas and agronomy lab

University of Copenhagen for a series of pot trials in growth chambers

Direct Enquiries to:

Professor Michael Walsh, E: michwalsh@csu.edu.au, M:0448 847 272