Curtin University

Food Science & Technology and Agriculture

MSc and Honours Projects 2022

Allocation of Projects

Students should review the list of available projects in this booklet, arrange to meet with potential supervisors, and then complete the table on the following page.

Allocation of projects will take into account a number of factors, including student merit, student preferences and interests, as well as allocation of students across available supervisors and workload of supervisors.

Please note that late submissions may result in the student being allocated to remaining projects after everyone else has been allocated. The onus may also fall on individual students to find their own supervisors and projects if they leave their decision too late.

To be submitted by email for Food Science to Associate Professor Ranil Coorey (r.coorey@curtin.edu.au) or for Agriculture to Dr Nicholas George (Nicholas.George@curtin.edu.au)

Please ensure that projects from 3 <u>different</u> primary Curtin supervisors are listed.

You can provide the information by using this form, or type ALL information into an email.

Student ID :	**Name :**
Contact Email Address:	**Contact Phone Number:**

Preference	Project Title	Curtin Supervisor
1		
2		
3		
4		

Food Science and Technology Projects

Dr Rewati Raman Bhattarai

Office: 303.283

Phone: 9266 5182

Email: r.bhattarai@curtin.edu.au

Background

I completed my PhD from the University of Queensland, Brisbane in 2018 elucidating the structure-property relations of plant cell walls. Afterwards, I spent two years at the Australian Export Grains Innovation Centre (AEGIC) understanding the wheat quality for various end products such Asian noodles, bread, and their textural and sensory attributes. My current research at Curtin focuses on innovations in alternative plant proteins from cereals and legumes for food and nutraceuticals. In collaboration with food industries, I am looking at developing food matrices using vegan, gluten-free, soy-free and non-GMO protein ingredients. Likewise, I am exploring innovative technologies to enhance techno-functionalities in different plant proteins. I am also working with world renounced scientists to investigate the role of di-tyrosine cross linking in visco-elastic properties in plant proteins and doughs. Currently, I have a successful ARC-L grant to develop the process for purification of the bioactive legume protein γ- conglutin as a nutraceutical for maintaining healthy blood glucose levels.

I am an advisory committee member of Australasian Grains Science Association (AGSA) and Secretary of Nutrition Division in Cereal and Grains Association, USA.

The role di-tyrosine in elasticity of non-gluten plant proteins (several projects)

Alternative plant protein sources are gaining popular globally, however, these proteins can lack the techno-functional attributes that is its ability to form structures within the food matrix to provide the mechanical or sensorial experience expected by consumers. Only a few plant proteins such as gluten have the viscoelastic properties in dough required for noodles. This gluten network is a protein matrix that contains covalent cross-linkages between glutenin and gliadin proteins. The responsible cross-links have generally been considered as di-sulphide bonds, however another cross-link, di-tyrosine may play a role in gluten visco-elasticity (Peña et al. 2006). In addition di-tyrosine bonds may play a role in the viscoelastic properties of proteins of some other gluten-free extensible plant proteins such those from marama bean and carob bean germ (Amonsou, et al. 2012). Our team at Curtin have developed a liquid chromatography-mass spectrometry (LC-MS) method for the accurate, precise and sensitive quantitation of di-tyrosine in plant proteins and doughs (Nguyen et al.

2017). We hypothesise that gluten like rheological characteristics in non-gluten proteins is associated with the level of their di-tyrosine contents.

This project will involve:

- Preparation of protein isolates from a range of plant protein samples (e.g. carob bean, wheat, legumes)
- Formation of doughs from the protein isolates and measuring their rheological properties eg. extensibility and viscoelastic properties (gluten-like properties)
- Modification of protein doughs using oxidising agents and measuring their extensibility and viscoelastic properties (gluten-like properties)
- Improvement of recovery and reduce signal suppression of the di-tyrosine analytical method
- Applying the improved method to a range of plant protein samples with differing rheological properties to identify and correlations between di-tyrosine level and gluten-like properties

Findings of this research will give us a new understanding the potential role of di-tyrosine in the rheological properties of plant proteins. This understanding may in the future assist in development strategies to induce viscoelasticity in plant proteins through di-tyrosine bond formation and thus design new gluten free protein ingredients with gluten like properties for the food industry.

Amonsou, E. O., Taylor, J. R., Emmambux, M. N., Duodu, K. G., & Minnaar, A. (2012). Highly viscous dough-forming properties of marama protein. *Food Chemistry*, *134*, 1519-1526.

Nguyen, D. D., Johnson, S. K. & Clarke, M. W. (2017). Identification and quantification of dityrosine in grain proteins by isotope dilution liquid chromatography-tandem mass spectrometry. *Food Analytical Methods,* 10, 3321-3328.

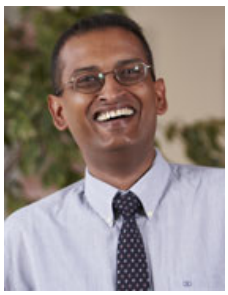
Pena, E., Bernardo, A., Soler, C., & Jouve, N. (2006). Do tyrosine crosslinks contribute to the formation of the gluten network in common wheat (*Triticum aestivum* L.) dough? *Journal of Cereal Science*, *44*, 144-153.

Associate Professor Ranil Coorey

Office: 303.291

Phone: 9266 1043

Email: r.coorey@curtin.edu.au



Background

My research interests are mainly in the area of food safety, both chemical and microbiological and food product innovation. My research includes the determination of composition and applications for Australian bush foods funded by the Food Agility CRC and the Indigenous Australian Bush Food Industry, the AMPC funded Red Meat Safety project and AAUN funded Chicken processing and safety project. I also have industry funded projects on value addition to Australian truffles and fruit. Another Department of Primary Industries and Regional Development sponsored project for students on brewery by-product utilisation. Some of my other work includes value addition to food industry by-products, such as applications for Australian banana peel and second grade banana. My work also includes the development of food ingredients from chia and quinoa. The product innovation research includes gaining an understanding of raw material interaction and performance during processing plus the development of commercially acceptable products. All of my publications based on student projects related these research can be accessed through Curtin's library. One of my objectives is to publish student research with them, which has helped students in their career development.

Australian Bush Food applications

The Bush Food projects are in collaboration with my Australian Indigenous Bush Food Industry. You will have the opportunity to work with a Community Elder. The two projects under this area are priority. You will be working in a team and will have a PhD student as a mentor.

Australian bush foods have been consumed by Australian Indigenous Communities for centuries. However, very few of them are listed on the Food Standards Australia New Zealand (FSANZ). Due to which there are restrictions on its usage and export. In recent years the demand for Australian Bush Foods have grown locally and for export. Due to the FSANZ restrictions, the growth in this industry has been limited. For the sustainable growth of the industry it is imperative to have these Bush Foods listed on FSANZ, which require the compositional and safety of the food is scientifically determined and demonstrated. Hence the industry is inviting research in this area so that these products can be widely applied to every day food. Under this research program there are few possible research projects and the selected students will be working with Australian Indigenous groups in carrying out their research

The student project series will identify the chemical, nutritional, anti-nutritional composition and its toxicological safety of selected Australian bush foods. The project will also include the determination of food processing techniques that can be applied to inactivate the anti-

nutritional and toxicological compounds. Once these are determined, the students may have the opportunity to develop a commercially acceptable food product. There are four separate student projects available under this topic based on four different raw materials / four different bush foods.

Identifying the chemical composition and safety of selected Australian bush foods

Industry partner: Swan Valley and Eastern Regions Inc (this project may have some funding). There are three separate projects available under this topic. The aim of the projects will be to determine the chemical profile of some selected Australian native bush food. The project will specifically look for known plant chemicals hazards

Determination of the nutritional composition of selected Australian bush foods

Industry partner: Swan Valley and Eastern Regions Inc (this project may have some funding)

There are three separate projects available under this topic. The aim of the projects will be to determine the nutritional profile of some selected Australian native bush food. The project will specifically look for known plant based nutritional and bioactive compounds and develop a food product that contain these nutrients.

Through these projects the student will gain skills in: literature searching; research design; critical appraisal of literature and data; data analysis; statistical analysis; database management; research project management; analytical chemistry methods and techniques among others. I also accept student ideas and interest that fall within my research program. Students are welcome to come and talk to me about their interest when deciding on the projects.

Food by-product utilisation

The projects in this area are in collaboration with the industry. You will be working in a team and will have a PhD student as a mentor.

Optimisation of the extraction of different pigments from banana peel for food application

Industry partner: Sweeter Banana cooperative. This project has potential patents and industrial confidentiality around it. Due to which details can't be publicised. If you are interested in further information me contact me

Determination of the composition of spent grain from the brewing industry and their extraction.

This project is funded for a student project by the Department of Primary Industries and Regional Development and the Industry. The project is to determine the nutritional composition of the spent grain that can be extracted for food applications. It would be beneficial if you can develop a functional food product incorporating one of the extracted components. This is a priority project.

All of my publications based on student projects related this research can be accessed through Curtin's library. One of my objectives is to publish student research with them.

Dr Janet Howieson

Office: Building 609:Rm 100
Phone: 9266 2034
Email: J.Howieson@curtin.edu.au

Master and Honours Project

1. Investigate the use of chitosan based edible coatings to extend the shelf-life of various finfish fillets. Chitosan has been proven as effective as a costing on meat products but very little work has been completed on a variety of fish fillets. Shelf-life extension will be examined by a range of sensory, biochemical, microbiological and instrumental chemistry techniques. Industry research funding is available for operational support of the research.
2. An industry partner, focusing on premium niche Australian seafood products, is keen to examine the sensory, nutritional and biochemical attributes of a range of dried flavouring products produced from seafood processing waste (eg finfish and abalone). The impact of different drying techniques on such characteristics will also be examined. Industry research funding is available for operational support of the research.
3. Investigate the use of fish enzyme hydrolysate, produced from fish waste, as an organic fertilizer when compared to traditional fertilisers. Assess by simple growth characteristics, enhanced protection against nominated stress and nutritional profile of the edible product.
4. Various Seaweed extracts have been informally reported to act as an alternate baking ingredient…but there has been little scientific study in this area. An industry partner has requested scientific validation of the role of seaweed extract with a view to developing a new product.

Agriculture Projects

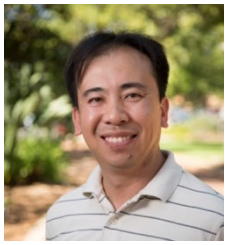
Dr Kar-Chun ('KC') Tan

Office: 303-251

Lab: 304 level 2

Phone: 9266 9916

Email: Kar-Chun.Tan@Curtin.Edu.Au



Background

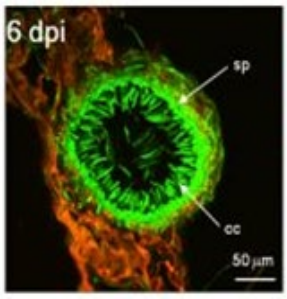
Parastagonospora nodorum is a serious necrotrophic fungal pathogen of wheat (right). In Australia, the pathogen is responsible for $108 million in yield loss of wheat per annum. *P. nodorum* is considered a model fungal pathogen as it possessed a near-complete genome, is genetically tractable and well-resourced. My laboratory is affiliated with the Centre for Crop and Disease Management (CCDM), a well-funded research organisation dedicated to devising novel crop protection strategies against economically important fungal diseases. Our research aims to decipher the mechanism of *P. nodorum* pathogenicity on wheat with an end goal to exploit weaknesses in fungal metabolism for plant protection purposes.

Dissecting the mechanism of fungal pathogenicity

We have identified a group of genes that are strongly expressed during wheat infection. These genes are implicated in plant cell wall degradation, nutrient assimilation, effector function and signal transduction. The project aims to deduce the role of these genes during host infection using a molecular genetic approach to generate gene deletion mutants. Fungal mutants lacking these genes will be assessed for pathogenicity and developmental defects using a wide range of genetic and biochemical techniques.

Regulation of necrotrophic effector expression in *P. nodorum*

P. nodorum secrete proteinaceous necrotrophic effectors (NEs) into the host tissue during infection. These NEs interact with the product of host dominant susceptibility genes to cause uncontrolled plant cell death leading to necrosis. This strategy allows the pathogen to infect and proliferate freely in the susceptible host. A recent study in our lab demonstrated that several major NE genes is subjected to positive regulation by the transcription factor PnPf2. However, it is not known what signals trigger or repress the expression of *PnPf2*. This project aims to introduce a PnPf2 promoter-reporter gene expression construct (such as the green fluorescent protein gene, *left*) into *P. nodorum* and determine changes in the fluorescent level when the fungus is exposed to abiotic factors such as nutrition and stress.



Genomics of fungal co-infection on wheat

The fungus *Pyrenophora tritici-repentis* (*Ptr*) causes tan spot of wheat and is closely related to *P. nodorum*. It was recently demonstrated that *P. nodorum* and *Ptr* often co-exist on a common necrotic lesion of susceptible wheat. However, more research is needed to determine whether *P. nodorum* and *Ptr* form a synergistic, antagonistic or neutral partnership during the infection process. This experiment aims to determine biomass accumulation of both pathogens during co-infection on a selection of wheat varieties that display differential effector sensitivity and disease resistance.

All projects will provide the candidate with excellent training in molecular biology, bioinformatics, biochemistry, proteomics, metabolomics, microbiology, histology and plant pathology. These skill sets are transferable across other molecular life science discliplines.

A/Prof. Sarita Bennett

Office: 303:227

Phone: 9266 2740

Email: sarita.bennett@curtin.edu.au

Background: Research has focussed around pasture ecology, rehabilitation of degraded land, and genotype by environment interactions, with an increasing interest in utilising digital technologies to improve site specific management and productivity. Since 2016 I have led projects within the CCDM on agronomy and management to reduce the incidence of sclerotinia stem rot in canola and pulses. Research project opportunities are therefore varied and include;

Myceliogenic compatibility grouping of *Sclerotinia sclerotiorum* isolates from the eastern states

A/Prof. Sarita Bennett (Curtin), Dr Pippa Michael

Myceliogenic compatibility grouping (MCG) is used as a phenotypic marker to determine genetic diversity in Sclerotinia isolates. We have already shown that there is significant diversity in isolates collected across Western Australia, both within and between paddocks. However, it is not known how this diversity compares to isolates of sclerotia in the eastern states of Australia. A collection of sclerotia from the eastern states is available that has been collected from the last two years, that can be compared to known reference isolates within Western Australia.

Activities: The project will be laboratory-based, and may include some molecular work

Suited to: Students interested in the ecology and genetic diversity of plant-diseases, and data analysis.

Places: This project is open to a single student. Other projects on Sclerotinia may also be available.

Additional information: Michael, P. J., K. Y. Lui, L. L. Thomson, A. R. Lamichhane, and S. J. Bennett. 2021. "Impact of preconditioning temperature and duration period on carpogenic germination of diverse sclerotinia sclerotiorum populations in Southwestern Australia." *Plant Disease* 105 (6)

Michael, P., K. Y. Lui, L. Thomson, K. Stefanova, and S. Bennett. 2020. "Carpogenic germinability of diverse Sclerotinia sclerotorium (Lib.) de Bary populations within the south-western Australian grain belt." *Plant Disease*

Improving site-specific management of crops and pastures using precision agriculture technologies

A/Prof. Sarita Bennett

The availability of precision agriculture and digital agriculture technologies is increasing in broadacre farming. However, there is still a significant gap between those who can produce

or download the data, and those who want to use the information. Data can be downloaded freely from satellite imagery, obtained from drones, headers and soil testing results and mapped to form variable maps across a paddock. However, what is the best information to use to determine site specific management, and is there a need for different information to answer specific questions.

Activities: The project will be predominantly computer-based, although may require some visits to field sites.

Suited to: Students interested in using precision agriculture technologies.

Places: This project is open to multiple students.

Additional information: McEntee, P. J., S. J. Bennett, and R. K. Belford. 2020. "Mapping the spatial and temporal stability of production in mixed farming systems: an index that integrates crop and pasture productivity to assist in the management of variability." *Precision Agriculture* 21 (1): 77-106

Industry-collaborative projects

Managing spring frost risk in Western Australian cereal production.

Dr Ben Biddulph (DPIRD), A/Prof Sarita Bennett, Dr Nicholas George, Dr Bec Swift (Curtin)

Radiant frost risk in spring is the single most important issue affecting wheat yield and profitability in the central agricultural region of Western Australia. DPIRD has a long-running research project aimed at understanding and addressing frost risk in cereals. A student has the opportunity to work with DPIRD on a project in this area.

Activities: The project will be field-focused and require travel to DPIRD and to field sites.

Suited to: Students interested in field-based research.

Places: This project is open to multiple students.

Taming the savage cabbage: Harnessing genetic diversity of wild Brassica species for canola improvement

Dr Matthew Nelson (CSIRO), Dr Jens Berger (CSIRO), A/Prof. Sarita Bennett (Curtin)

Overview: Canola is Australia's most important oilseed but it has a problem: Depleted genetic diversity that hinders its ability to adapt to a changing climate and ever-evolving pests and diseases. Fortunately, plenty of genetic diversity is available in its wild relatives field mustard and wild cabbage. There are international efforts underway to collect these relatives from the wild and use them to improve canola through new breeding methods.

This project will involve a combination of desk-based (identifying the most promising wild relatives for canola improvement), field work (evaluating wild relatives) and glasshouse work (crossing canola with its wild relatives).

Who? If you interested in the sustainable improvement of crops, want to develop diverse research skills and experience a multidisciplinary crop improvement team in action, this

project is for you. Basic computer skills are required. Some interest in applied genetics is desirable but not essential.

Where? CSIRO Floreat

Additional information: McAlvay et al. 2018 Barriers and prospects for wild crop relative research in *Brassica rapa*. DOI 10.17660/ActaHortic.2018.1202.24.

Various research projects on wheat, canola or lupins

Dr Dion Bennett (AGT, Northam) + various Curtin supervisors

Yield, Yellow Spot and Adaptation; Quantifying the yield response of Yellow Leaf Spot resistance independent of Vrn-B1

Alkaloid levels in Lupins – validation of high throughput selection tools

Variety x agronomic management interactions and their effect on physical grain quality

Or bring your own concepts/ideas!

Contact: Dion.bennett@agtbreeding.com.au or 0400 031 911

Dr Fredrick Mobegi

Office: 304.337

Email: Fredrick.mobegi@curtin.edu.au

Background

My research at the Centre for Crop Disease Management (CCDM) is mainly focused on Ascochyta genomics, specifically on utilizing genomic and transcriptomic sequencing to understand the development and evolution of virulence and pathogenicity in Australian *Ascochyta rabiei* and *Ascochyta lentis* isolates. Currently, we have generated genomic sequencing data based on PacBio and Oxford nanopore long-read sequencing platforms, and Illumina short-read platform. These data have facilitated the assembly and annotation of near-complete genomes to further our exploration. In addition, we have also generated RNAseq data of *in vitro* and *in planta* infection assays to study gene expression profiles during the interactions between these pathogens and their hosts.

The Research Group

At the Centre for Crop and Disease Management (CCDM; Curtin University and Grains Research and Development Corporation co-funded research center), our research theme focuses on genetic diversity of fungal isolates from field collections, variation in virulence and aggressiveness of isolates, fungal genomics, and host resistance of chickpea germplasm. The project will be fully integrated within the CCDM Theme C Project 3 that is funded to provide molecular biology consumables, genome sequencing and plant genotyping, as well as reliable computing resources (through the Pawsey Supercomputing Centre). The project will tap into ongoing monitoring programs to provide isolates and associated phenotypic data from Australian *A. rabiei* and *A. lentis.*

Masters and Honours project Summary

This project will use PacBio single-molecule real-time (SMRT) and Nanopore long-read sequencing, combined with Illumina short-read sequencing to assemble and evaluate chromosome-level quality genomes of Australian *A. rabiei* and *A. lentis* isolates exhibiting varied aggressiveness. The assemblies will facilitate the identification of loci relevant to pathogenicity, and aid in-depth comparative analyses to provide crucial insights into functional diversity and genetic variations among isolates. The inclusion of international

isolates and the construction of a pangenome will also aid the investigation of chromosomal rearrangements and their potential impact on the evolution of virulence and aggressiveness.

RNAseq data will also enable us to identify and characterize genes differentially expressed during infection in the *A. rabiei- Cicer arietinum* and *A. lentis- Lens culinaris* pathosystems.

Findings from these studies will improve comprehensive characterization of interactions in the chickpea-Ascochyta or lentils-Ascochyta pathosystems and help identify molecular factors that play a role during infection.

Ideal for

This project will be bioinformatics-oriented (compute-intensive) and will require candidates to work on High Performance Computing (HPC) servers.

Interested applicant(s) will have strong interest in **applied bioinformatics** demonstrated through relevant coursework, formal training, or research. Ability to compute in Unix OS, Statistical and programming skills with experience in at least one programming language (R, Python) are necessary to succeed in this project.

I (Dr Fredrick Mobegi) will support and mentor the successful candidate(s), with help from Project Leaders Dr Robert Lee (*A. rabiei*)/Dr Bernadette Henares (*A. lentis*) and Senior Theme Leader, Dr Lars Kamphuis with expertise in biochemistry, molecular plant pathology and bioinformatics. Technical expertise and guidance in bioinformatics and molecular plant biology techniques will be available from researchers working across Theme C projects.

Jordi Muria-Gonzalez

Office: 304-228

Lab: 304 level 2

Phone: 9266 7964

Email: jordi.muria@curtin.edu.au

Background

One of the mayor diseases of barley, net blotch, is caused by two closely related fungi producing each a distinct form of the disease: the net type net blotch (causal agent: *Pyrenophora teres* f. *teres*) and the spot type net blotch (causal agent: *Pyrenophora teres* f. *maculata*). Without any control measures in place, losses from this disease would exceed $300 million, with spot form net blotch rated as the costliest disease affecting barley in Australia (Murray and Brennan, 2010).

Although the mechanisms of this disease are not well understood, there is evidence that barley has both , resistance and susceptibility genes that interact with virulence factors (also known as effectors) secreted by these pathogens, enabling either resistance or susceptibility to net blotch. Nevertheless, the confirmation of this at a molecular level is yet to be found. Therefore, the main objective of our lab is to unveil the molecular basis of the disease.

We aim to identify and functionally characterise the virulence factors of this disease and the resistance/susceptibility genes of the host. In doing so we will be able to provide breeders tools that may help generating net blotch resistant barley varieties.

Project: Proteomic analysis of *Pyrenophora teres* f. *maculata*

In this project you will investigate the fungal proteins that are produced during the plant infection and identify those associated to disease development. Your work will be split in two, a laboratory part to obtain the necessary data, and a computational analysis of the experimental results. For the first part you will culture an aggressive isolate of the fungus causing the spot type net blotch and a non-aggressive strain; you will use these isolates to infect a susceptible and a resistant barley variety from which you will then extract the fungal and plant proteins; the extracted proteins will then be sent to be analysed by liquid chromatography-mass spectrometry. The computational work starts when results are returned, you will identify what are the main types of proteins being expressed during the infection and which ones are more likely to be disease determinants.

If you want to know what other projects we have, contact us to visit our lab.

Simon Ellwood

Office: 304-228

Lab: 304 level 2

Phone: 9266 9915

Email: Simon.ellwood@curtin.edu.au

Background

Our lab investigates one of the mayor fungal diseases of barley, net blotch, causing millionaire losses to the Australian barley industry. Unfortunately, little genetic resistance exists among current commercial barley varieties. Furthermore, it is becoming more frequent to find isolates of this disease which are tolerant to the fungicides used to manage them, rendering the control measurement ineffective.

Our objectives are to identify the key molecular players of the fungal-plant interaction in order to aid on the development of genetically resistant barley varieties.

Projects: reverse genetics of virulence factors from barley Net blotch

While a forward genetics approach looks for the gene responsible for a specific phenotype, reverse genetics looks for the phenotype produced by a gene when changed or removed. As a part of this project you will use reverse genetics to identify the function of small genes from barley net blotch which encode putative effectors, toxic molecules that either enable or prevent the fungal infection

Dr Nicholas George

Office: 303.221

Phone: 9266 1755

Email: Nicholas.George@curtin.edu.au

Exploring farming systems using the APSIM crop model

In coming decades, growing populations and rising affluence will require global farming systems to produce ever increasing amounts of food. Meanwhile, factors like land degradation and climate change will fundamentally stress and reduce the productivity of these farming systems. APSIM is a farming systems simulation model that is widely used for research and farm management around the world. Students are invited to undertake a research project that will use APSIM to explore agricultural questions. These can relate either to Australia or their home country. Project work will be computer-based and require students to engage in data sciences and data analytics in the R programming language. Although desirable, there is no requirement for a student to have previous experience or training in APSIM or R. Instead, this project can be an opportunity to develop these skills, although the student must have a willingness to learn and show a high level of independence.

Activities: The project will be computer-based and may require the collection and synthesis of existing published data for model testing.

Suited to: Students interested in computer-based crop modelling, model-assisted decision support, data sciences, and data analysis.

Places: This project is open to multiple students.

Additional information: https://www.apsim.info/