An adaptive irrigation system is being developed for the horticulture industry. This system, which will also help optimise nitrogen application, is being trialled in Queensland’s Fassifern Valley and Hawkes Bay and Palmerston North in New Zealand.

The project has been made possible by funding sourced through an early-career Queensland Government Accelerate Fellowship, and aims to improve irrigation and fertiliser application in horticulture using real-time, adaptive control.

The three-year project kicked off in August 2014 and will evaluate a proof-of-concept system that controls site-specific irrigation and fertiliser application.

Similar trial work in the cotton industry had helped to deliver water savings of up to 10 per cent and, through this project, we are looking to extend that to crops such as corn, beans, onions and carrots.

We have developed a control system that can determine site-specific irrigation requirements using a weather station, soil moisture sensors and plant growth and vigour. The system will not over-water or under-water the crop and will provide irrigation only to the parts of the field where it is needed. We are looking to improve water use in space and time.

This project has linked my team at the University of Southern Queensland’s National Centre for Engineering in Agriculture (NCEA) with Landcare Research New Zealand. Their research on adaptive irrigation based on soil-moisture measurement on crops and pastures at sites across New Zealand is also being conducted.

“In our project we are focusing on using off-the-shelf sensors and low-cost loggers to develop adaptive systems”

With this ‘Accelerate’ funding, we will also be looking at incorporating plant-based measures for irrigation management.

The hardware will be used to look at vegetation and fruiting of plants which, in conjunction with information from sensors, will build up a picture of the crops’ vigour.

We are using infra-red vision to detect stress, which could be caused by lack of moisture or nitrogen, and we will develop a system that can automatically analyse this data and determine irrigation and nitrogen requirements.

The information could be used to develop predictive data which would be useful in determining crops’ water and fertiliser needs throughout the growing season.

This Accelerate project capitalises on mechatronic technology for which NCEA has become widely known. Mechatronics combines electronics and mechanical engineering.

The NCEA team is conscious of developing precision agricultural systems that will be affordable to farmers.

With that in mind, the loggers and data processors we are using are based on off-the-shelf smartphones, which are low cost, and have on-board processors, GPS, and are internet enabled.

Data from this hardware is conveyed via a smartphone app developed by NCEA engineer Victor Skowronski.
ed Windley is quietly confident that trial work conducted by Dr Alison McCarthy will help to lift vegetable yields on his south-east Queensland property by supplying irrigation and fertigation at varying rates. This work is on two paddocks which are a mixture of three different soil types. A field trial is now being set up and includes the retro-fitting of 50 solenoids on his centre pivot, which waters a seven hectare paddock, and a further 300 on the pivot, which waters a 20ha paddock. An electromagnetic (EM) survey has mapped his paddocks into three main soil types — grey loam, deep red and heavy alluvial clay. The EM information is used in conjunction with a desktop software program that tells the solenoids where more or less water and fertiliser are needed. By targeting water and fertiliser, Mr Windley is hoping for paddock yield gains of between 10 and 20 per cent.

The software has been developed by Dr McCarthy and her team at the National Centre for Engineering in Agriculture (NCEA). It is capable of closing the solenoids when water pumped through the centre pivot is passing over heavier soils and giving the lightest soils maximum water.

“By installing a variable rate irrigation (VRI) system on a centre pivot gives me the ability to create different input zones in terms of soil types and crop growth,” Mr Windley said.

As a supplier to Kalfresh and Mulgowie Farming Company, Mr Windley plants carrots, green beans, onions and sweet corn six days a week to ensure a crop grown over a set timeframe can be harvested six days a week on the Windley’s property, “Kengoong”, in the Fassifern Valley at Kalbar near Boonah. Some yield sampling by NCEA staff has been done on “Kengoong” in recent years using Normalised Difference Vegetation Index (NDVI) imagery collected by a motorbike-mounted sensor, and this data is being used in the fertigation trial to help determine water and fertiliser needs.

“The problem we have is that if areas of the crop are not ready for harvest because they have had less nutrition or irrigation, they come off anyway because of the timetable we work on, and that can mean our yield is quite severely affected.

“Our goal with this trial is to lift the uniformity of harvest, and at the moment the only way we can do that is to manually change the rates on our fertiliser spreader to take into account the additional needs of the lighter soils.

“That relies on a fair bit of guesswork, and the trial we hope will ultimately result in a commercial product that will repay any investment in hardware and software in a few years.”

This kind of technology and automation offers the next opportunity for significant change in agriculture, and we are focusing on using off-the-shelf sensors and low-cost loggers to develop adaptive systems which are not prohibitively expensive.

Through the Accelerate Fellowship with Landcare Research New Zealand and in other projects, my team at NCEA is looking at using the control system to irrigate crops across a range of industries. We developed the control and sensing system to be applicable for any crop and irrigation system, which creates opportunity for increased efficiencies in lots of industries including dairy.

Biog: Dr Alison McCarthy is a research fellow at the University of Southern Queensland’s National Centre for Engineering in Agriculture who specialises in mechatronics. She is based in Toowoomba.

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