INTRODUCING PRECISION AGRICULTURE TO HIGH SCHOOL STUDENTS IN AUSTRALIA

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ABSTRACT

With a growing population and land available for agricultural production declining, there is a need to produce more food with less. The use of precision agriculture technologies at a selective high school student conference, Generation2050: Project Feed the World was held at UNE in December 2013. From all Australian States and the Australian Capital Territory, 101 students were chosen to attend from 161 applications based on a short written essay and the subjects they were studying at school. Over the four day event students were exposed to numerous agriculturally based activities in science laboratories and in the field. One of the student nominated highlights was the precision agriculture sessions.

Keywords: agricultural education, high school students, careers, tertiary study

INTRODUCTION

By the year 2050 the world population is expected to reach 9 billion and with this comes the need to increase agricultural production to ensure there is enough food for the globe (Hatfield & Kitchen 2013). There is a growing need for tertiary qualified graduates in the Australian agricultural industry with only 7% of those employed in the sector holding a tertiary qualification compared to over 25% for the national workforce (Pratley 2008). With the need to greatly increase food and fibre production to feed and clothe a growing global population, and the adoption of precision agriculture technologies playing a huge part in this task, it is worrying that the demand for tertiary courses in agriculture in Australia is not higher. Additionally, the demand for skilled professionals in agriculture is not being met with over 4000 jobs in the sector been advertised but annually universities are only producing about 800 graduates (Pratley 2008).

To address the shortage of agricultural graduates, the School of Environmental and Rural Science (ERS) at the University of New England (UNE), Armidale, New South Wales Australia undertakes an extensive outreach program across the country designed to encourage high school students to consider tertiary study in the agricultural industry. This program consists of visits to high schools and events which bring students to the UNE campus. A very important aspect is to introduce precision agriculture (PA) to these students and highlight how technology is used to increase food and fibre production.

Between Sunday1 and Wednesday 5 December 2013, ERS hosted a selective agricultural student conference, Generation2050: Project Feed the World at UNE. To attract the best and brightest agricultural students from across Australia the conference was free of charge including travel to and from UNE from their home. Students participated in a variety of activities in the field, lab and lecture theatre on a wide range of topics related to agriculture including the sheep and wool industry, agribusiness and soil science. An important part of the program was to educate students on technologies used in the agricultural industry.

All students participated in 3 x 30 minutes sessions on PA at Kirby one of UNE's rural properties. Topics covered were the national broadband network (NBN) farming, biomass sensing and the spatial monitoring of livestock.
These programs are often the first time students come into contact with the term 'precision agriculture' and the associated concepts. It is clear from the evaluation of PA activities that students appreciated the opportunity to learn about new technologies and how they apply to agricultural enterprises.

The objective of Generation2050: Project Feed the World was to highlight to high school students the numerous and wide variety of careers available in the agricultural industry, whether they be on farm, in science or in the service sector. It is hoped that this knowledge will encourage students to undertake tertiary study in agriculture to prepare them for the workforce. The aim to grow enrolments in agricultural based courses at UNE through activities such as Generation2050 has been successful with an increase in enrolments of between 10-15% per annum for the past three years.

APPLICATION PROCESS

Generation2050 was open to high school students currently in Year 10, 11 and 12 (15-18 year olds) from across Australia. Selection was based on the student's 500 word essay on why Australian agriculture is vital to feeding the world in 2050, the subjects they were currently studying and the details of a teacher who was willing to provide support for their application.

There were 161 applications received for the 101 places available. There was over double the number of female applicants compared to males (Table 1). Generation2050 was most popular with Year 11 students, followed by Year 10 and then Year 12 (Table 2). It is understandable that there were fewer Year 12 students who applied to attend as the conference was held in December when they

had already finished school. Students from all States and the Australian Capital Territory (ACT) where represented at Generation2050 (Table 3).

Table 1. Number of applications and successful participants based on gender

	Female	Male
Applications	119	42
Successful participants	76	25

Table 2. Number of applications and successful participants based on year level

	Year 10	Year 11	Year 12
Applications	57	67	37
Successful	45	52	4

Table 3. Number of applications and successful participants based on each State and Australian Capital Territory

	ACT	NSW	QLD	SA	TAS	WA	VIC
Applications	2	74	33	25	2	8	17
Successful	2	32	24	19	2	7	15

PRECISION AGRICULTURE SESSIONS PRESENTED AT GENERATION2050: PROJECT FEED THE WORLD

The three PA sessions were presented at one of UNE's rural properties 'Kirby' allowing students to see how the technologies are used on a working property. Session 1 was on the 'Future of Farming' presented by Professor David Lamb, session 2 on 'Livestock Tracking and Virtual Fencing' with Dr. Mark Trotter and Mr. Zac Economou and session 3 'Biomass sensing' by Mr. Derek Schneider. Students were broken into smaller groups of 20 and rotated around each of the activities spending 30 minutes at each station. The small groups allowed students more interaction with each of the presenters as well as the opportunity to have any of their questions answered.

Future of Farming session

Professor Lamb interacted with the students around the topic of, the future of farming, as it will be by the time they enter the workforce. The conversation (as it was interactive, rather than a presentation to a passive audience) covered the intertwined topics of precision agriculture, the internet of things (IoT), sensor networks, national broadband networks (in other words the role of high-speed internet on and around farms), the growth of a remote (virtual) smart services sector (including PA service providers), and the array of tele-services including tele health, tele agronomy, etc).

This took place on the UNE's SMART (sustainable, manageable and accessible rural technologies) Farm (www.une.edu.au/smartfarm) on which is was possible to demonstrate some of the discussion points in action, including a livestock tracking system, use of high speed internet video conferencing and live data exchange to provide a remote pasture diagnosis and advisory service, Pastures from Space, a 100-node environmental sensor network and live asset tracking (in this case ATV tracking).

Biomass sensing

Mr. Derek Schneider hosted a session which introduced attendees to the basics of global positioning systems (GPS) and optical biomass sensing; two technologies commonly used in PA. The session covered the theory of GPS; how GPS satellites continuously transmit time stamps and GPS receivers across the globe collect those signals and perform calculations to position themselves. The concept of how a differential GPS works to correct some inaccuracies caused when the radio waves are transmitted through the atmosphere from the GPS satellites to improve its accuracy was also discussed. Students learnt why the GPS is such an important tool for PA, enabling the spatial logging of numerous plant, animal and soil sensing devices and briefly the way that data is collected and processed.

The core objective of the session was used to introduce students to the application of optical vegetation sensing in precision agriculture, whether it be from remote sensing satellites or high level passive aerial systems or the newer plant proximal active optical sensors which are being widely adopted in agriculture. Active optical sensing differs from traditional remote sensing in that it does not rely on the ambient light, sunlight, to illuminate the target. This removes many calibration issues experienced when comparing between data captures. Active optical sensors illuminate the target with LED's in specific wave bands to allow the use of the same vegetation indices traditionally used in remote sensing alone. Being ground or low-level aircraft mounted means there is a rapid, or even instantaneous, data turnaround time, essential for managers in today's agriculture environment trying to monitor and provide crops and pasture with the best growing conditions to maximise yield and livestock weight gains.

Livestock tracking and virtual fencing session

Dr. Mark Trotter, Senior Research Lecturer in Precision Agriculture and Zac Economou, Research Fellow ran the session on livestock tracking and virtual fencing. Generation2050 students were introduced to some of the future possibilities of technology for livestock producers, including GPS collars and virtual fencing units.

Students were given demonstrations of how these technologies work (only receiving mild stimulus from the virtual fence) and were encouraged to think about the applications of these technologies and the possible benefits for livestock producers. It was obvious from the questions and discussion that students were thinking of how these technologies could be applied on farm and the possible benefits and problems faced when applying these technologies. This is the most important aspect when presenting future technology, relating it back to the production system and demonstrating how it can benefit producers.

With virtual fencing in particular it was clear that students could see the benefits for graziers and were very interested in how it could be further developed and when they could apply it on their own properties. They also quickly grasped how virtual fencing could change livestock management decisions such as stock movements and pasture management. Additionally they developed an understanding for how livestock tracking could be applied on farm to assist in tasks such as behaviour monitoring and disease detection.

Fig. 1 Students under the guidance of Zac Economou testing out virtual fencing units.

Fig. 2 Students under testing out virtual fencing units.

Fig. 3 Students learning about active opical sensors.

Fig. 4 Student testing out a hand held active optical sensor.

FEEDBACK

When asked to score each session based on how informative and enjoyable it was out of 10, PA sessions ranked very highly. The 'Future of Farming 'session which focused on connecting farms to new technologies was scored 8.1 out of 10. The session on 'Biomass sensing' which consisted of information regarding active optical sensors and how these relate to pasture biomass was rated 8.6 out of 10. The spatial monitoring and tracking of livestock was ranked as the most enjoyable and informative session by students with a score of 9.0 out of 10. This activity introduced students to the concepts of using GPS collars to track cattle and sheep to determine the pasture utilisation as well as the potential use of virtual fences. The average score for all activities at Generation2050 was 8.0 out of 10. The overall level of satisfaction from students who attended the conference was 9.6 out of 10.

Comments from participants regarding precision agriculture

Students were surveyed at the conclusion of the event. One of the questions was 'Since attending this camp, has your interest in the agricultural industry changed?' with several responses indicating Generation2050 had made them aware of the use of technology in agriculture;

Yes – I have become much more passionate and it has encouraged me to use technology which I don't know much about.

Yes it has made me more interested in the future technology.

I'd say it has increased as earlier I was more interested in the animals and had some passion for agriculture but now are considering more agricultural or technology based studies.

Yes I think I'm more interested in gains, pastures and cutting edge technology.

These comments demonstrate that the PA sessions at Generation2050 were well received and effective in promoting the use of technologies on farms to improve productivity. Due to the high level of interest in the PA sessions from students, more content on technology and how it is used in the agriculture industry a greater number of or longer sessions may be incorporated into future conference programs.

CONCLUSION

The inaugural Generation2050: Project Feed the World student conference was a great success demonstrated by the very high overall satisfaction score given by the attendees and the demand for places. It is hoped that by bringing the best and the brightest agriculture students from across Australia to allow them to learn and create lasting networks, there will be an increase in enrolments in tertiary agriculture courses. One of the attendee nominated highlights was the sessions which incorporated the use of PA and therefore future programs will have an increased level of content about technologies used in agriculture to improve on-farm productivity. As these experiences are often the first time students are exposed to the concept of PA, to increase its adoption across the country continued education is required. Generation2050: Project Feed the World is just one example of how tertiary bound agricultural students can be given an insight into the use of PA in Australia.

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