

# **Workshop on precision agriculture and mechanisation in vegetable industry**

Richard Mulcahy  
AUSVEG Ltd

Project Number: VG10108

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# **VG 10108**

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A seminar for applying precision agriculture and  
mechanisation to the vegetable industry

Richard Mulcahy AUSVEG Ltd

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The purpose of this report is to provide feedback and recommendations from Growers on their views on the use of mechanisation as they see it in the future of the vegetable industry. This report is intended to be used by the vegetable IAC and other investment decision making bodies as a guide for what growers have identified as priorities in their businesses when making recommendations on future mechanisation investment decisions.

As outlined in the project proposal the seminar was planned as a result of a request made by the vegetable IAC and Advisory Groups in September 2010. While the seminar was originally put forward as a Project Definition by an Advisory Group in March 2010, it has since been identified that the area of mechanisation in the vegetable industry is a key priority going forward.

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## **Media Summary**

The mechanisation seminar was held on Wednesday 13 April 2011 at the Sebel-Citigate Hotel in Brisbane. The seminar saw 25 growers brought together to discuss their opinions on where the industry should be investing R&D dollars in the future of mechanisation as it has been recognised as a priority by the vegetable IAC. The seminar also served as a benchmark for the industry speakers present at the seminar to assist them with identifying future innovations to their product range that can be produced for growers.

The seminar promoted open dialogue between researchers, growers and industry service providers to identify what growers desire to see implemented on their properties.

The key outcomes from the seminar were that growers desire a catalogue or database of mechanised products from other countries to assist them with researching. A resource such as this will be an effective method of saving time for growers as well as a tool for domestic companies looking for products to adapt to Australian conditions or design a niche product not available elsewhere.

The second outcome was for a scoping study be conducted to address grower concerns that mechanised harvesting aids are not available (both domestic and internationally) in many labour intensive commodities. The study would investigate the top 5 commodities that do not have harvesters available (for example: exclude potatoes and carrots as they are already substantially automated in the harvesting process) and look at the processes that are currently in place when harvesting them and identify how to automate this.

It was concluded that the Australian horticultural community is not yet large enough to support the design of new products by companies solely catering for Australia. It is suggested that designs may be better adapted to Australian conditions rather than reinventing the wheel.

Future R&D projects should bring together the group that was established at the seminar and continue to gauge their feedback as these projects are put forward and research is conducted. This would be strongly encouraged if the scoping study is undertaken.

## **Introduction**

Mechanisation has emerged as a priority for the vegetable industry following several Advisory Group and Vegetable IAC meetings in 2010, and following the *Mechanisation, Automation, Robotics and Remote Sensing (MARRS) for Australian Horticulture* project (HG09044).

The objective of project HG09044 was to review the opportunities and likely impediments for the development and implementation of MARRS technologies into Australia's horticulture industry. The project developed a strategic vision and plan (based upon case studies, a review of current and future expectations across the horticulture industry, and an analysis of competitive overseas trends), to help advise Australia's horticulture industry and Government in relation to future investment into MARRS for the industry.

The SWOT analysis undertaken as part of the initial MARRS workshop showed there were looming threats from labour shortages and associated rising costs threatening the industry's competitiveness. It was also identified that Australia's horticulture industry lacks leadership in the areas of MARRS developments. It was proposed that as MARRS technologies are developed and taken up, the cost of MARRS technologies will decrease. It was also proposed that the export of Australian expertise in MARRS has the potential to become an industry itself. The Project Definition for the Mechanisation Seminar was put forward to the Vegetable IAC by the Information Technology Development and Dissemination Advisory Group following their meeting in March 2010.

The Advisory Group put forward the Project Definition for the Mechanisation Seminar when reviewing the three projects for potential recommendation to the Vegetable IAC for funding endorsement. It was felt by the group that the projects were unable to deliver on outcomes and there was a need to draw the relevant stakeholders together for a seminar on an area that is becoming increasingly important to the industry.

In regards to future investment in the area of mechanisation R&D, solutions devised by future project applicants must be cost effective and affordable to Australian growers. The issue of mechanisation was then discussed in Advisory Group and Industry Advisory Committee meetings throughout 2010. Mechanisation was formally put forward as the subject of an Industry Priority for 2011/12 during the Vegetable IAC meeting on 14 September 2010.

The next Working Group meetings were scheduled for 13 April 2011 and sought to set priorities for the industry in 2011/12. Mechanisation is already a formal priority, however, further priorities or issues relating to mechanisation arising from these meetings were brought forward for further discussion as part of the Mechanisation Seminar. A provision for approximately 30 attendees to the seminar was made, with final numbers depending on the number of willing and able participants. The broad scope of attendees at the Seminar will ensure integration of different skills and value for growers.

The primary objective of the seminar was to identify how to reduce the cost of labour in vegetable supply chains through opportunities in the area of mechanisation, as labour

makes up a significant percentage of overall production costs incurred by vegetable growers. The scope of the seminar was not limited to production of vegetables, but included any activity that reduces costs in the supply chain. While some products developed overseas are available in Australia, many can't be used without adaptation to Australian conditions, and many products developed overseas never enter the Australian market as the industry is often seen as too small a market to target. The agenda also included the opportunity to address the difficulties in applying technologies on farm, including the implementation of new technologies and the affect this can have on business processes. The implementation of new technologies has been identified as a key issue.

The purpose of the seminar was to discuss and identify opportunities in the area of precision agriculture and mechanisation in the vegetable industry and to fulfill the request made by the Vegetable Industry Advisory Committee (IAC) in September 2010.

The second aim of the seminar was to facilitate the development of the industry's involvement in innovation and opportunities, and foster ideas that could be used in setting the future direction of the industry when projects in this field are being considered.

Two previous projects that were commissioned by HAL were investigated prior to the Mechanisation Seminar. These projects included: HG09044- Mechanisation, Automation, Robotics and Remote Sensing (MARRS) in Australian horticulture (Rankin, 2009) and VG08087 - Opportunities and challenges faced with emerging technologies in the Australian vegetable industry (Estrada-Flores, 2010). The investigation of the projects was to identify the areas the seminar would focus on and what research had been completed prior to the seminar.

Estrada-Flores' report chapter entitled "... technologies for Production and Harvesting" provides an overview from a broad food-chain perspective, based on a survey of HAL investment, rather than the outcomes of this investment. It reports that investment in mechanisation/Precision Agriculture (PA) represents approximately 10 per cent of total investment, but truly innovative projects are uncommon. The author makes few direct comments on mechanisation and harvesting technology, and only two of 12 cited examples are Australian. The recommendations suggest opportunities for collaborative work on precision agriculture with other R&D agencies and greater investment in protected cropping.

Russel Rankin's MARRS report makes an excellent case for investment in robotics for horticulture, but includes little reference to overseas developments in this area, some of which (e.g. independent fruit picking) appear to be advanced to the stage of significant corporate involvement. Agricultural robotics clearly represents a promising generic R&D investment opportunity, but reluctance is understandable when overseas technology appears likely to meet many of our needs.



Both reports note or imply the need for a bio-system engineering approach to developing sophisticated agriculture machinery adapted to Australian conditions and to the rapid decline in Australian machinery innovation. They could also have pointed out the simultaneous disinvestment in agricultural and bio-engineering by CSIRO, Universities, most State Government Departments and Rural Research and Development Corporations. Regardless of the cause, there are now few people with this training in our research institutions. Commercial organisations with this capacity also exist in Australia.

The seminar was intended to focus particularly on field mechanisation and automation. It is nevertheless useful to note that most current automated or robotic applications in horticulture take place in protected environments: packhouses, glasshouses or nursery/seedling/propagation systems. These environments use technology adapted from industry.

## **Mechanisation Seminar Delegate List**

<b><u>Name</u></b>	<b><u>Region</u></b>	<b><u>Category</u></b>	<b><u>Company:</u></b>
Michael Nixon	Carnarvon WA	Grower	Riverlodge Assets
Robert Kuzmicich	Carnarvon WA	Grower	
Paul Shain	Carnarvon WA	Grower	Desert Bloom
Charlie Bologna	Baldivis WA	Grower	West Hill Farms
Paul Gazzola	Somerville VIC	Grower	Gazzola Farms
Andrew Bulmer	Lindenow VIC	Grower	Bulmer Farm Fresh
John Said	Werribee VIC	Grower	Fresh Select
Mark Kable	Forth TAS	Grower	Harvest Moon
Andrew Craigie	La Trobe TAS	Grower	
David Whishaw	Carrick TAS	Grower	
David Ellement	Hammond Park WA	Grower	Monte Farms
Luke Biochich	Lancellin WA	Grower	West Hill farms
Colin Houston	Richmond TAS	Grower	Houston farms
Danny De Ieso	Angle Vale SA	Grower	Thorndon Park Produce
Rodney Emerick	Bowen QLD	Grower	Mulgowie Farms
David De Paoli	Bundaberg QLD	Grower	Aust Chilli
Matthew Hood	Gatton QLD	Grower	Rugby Farms
Richard Gorman	Kalbar QLD	Grower	Kalfresh
Robert Hinrichsen	Kalbar QLD	Grower	Kalfresh
Ed Windley	Kalbar QLD	Grower	
John ETTY	Northern Territory	Grower	Wildfarm
Jeff Mcspedden	Bathurst NSW	Grower	JW&FJ McSpedden
Paul Grech	Theresa Park NSW	Grower	Grech Farm Trading Pty Ltd
Ian Willert	Lara VIC	Supplier	Boomaroo Nurseries
Theo Jacometti	Lara VIC	Supplier	Boomaroo Nurseries
Alan Rogers	Berwick VIC	Supplier	Transplant Systems
Kevin Platz	Crestmead QLD	Supplier	John Deere
Paul Vaughan	Warrigal VIC	Supplier	Williames Pty Ltd.
Tony Russell		Seminar Moderator	
Jeff Tullberg		Seminar Planner	
Richard Mulcahy		Seminar Initiator	
Clyde Campbell		Speaker	MARRS
John Mcphee		Speaker	TIAR
Don Yule		Speaker	CTFS
Brett Whelan		Speaker	ACPA
Troy Jensen		Speaker	NCEA
Will Gordon		Observer	Horticulture Australia
Kathryn Lee		Observer	Horticulture Australia
David Moore		Observer	Horticulture Australia
Ravi Hedge		Observer	Horticulture Australia
Denise Kreymbourg		Observer	BDGA
Greg Spinks		Observer	CIS
William Churchill		Observer	AUSVEG

Rick Durham  
Courtney Burger  
Stephanie Bellasai  
Lisa Higginson

Observer AUSVEG  
Minute-taker AUSVEG  
Minute-taker AUSVEG  
Minute-taker AUSVEG

## **Seminar Details:**

The seminar was sectioned into four topics required to discuss ways to achieve a mechanised system on farm. These were outlined in the seminar briefing document circulated to all attendees in the fortnight before the seminar (appendix 1). The briefing document also contained the seminar agenda as well as the list of speakers and the generic question that was asked of the growers. To encourage discussion by growers a keynote speaker on each topic introduced concepts to attendees, speaking for no longer than 15 minutes to start discussions on what growers would see as areas of interest to their businesses. These were then followed by two shorter speakers from industry suppliers to propel the discussions further. The four topics that were covered in the seminar were as follows:

1. Precise Technologies – The Opportunities  
Precise management of crops and machines (spatial technology applications).
  - a. Precision guidance capability evaluation (RTK GPS/vision systems).
  - b. System impact assessment of precision in field layout/planting/crop protection/harvest/post-harvest and quality.
  - c. Crop/machine performance monitoring technology for management and QA.
  
2. Precise Technologies – The Impact  
Soil health/environmental effects of precise management.
  - a. Evaluating dollar value benefits of better soil management (less tillage and traffic).
  - b. Equipment development for minimum-disturbance high-residue operation.
  - c. Impact of field layout on water, traffic and logistics.
  
3. Site Specific Agriculture
  - a. Crop condition assessment (remote and proximal sensing; yield monitoring technology; UAV/satellite/imagery, including resolution and timeliness issues).
  
  - b. Site-specific management (dependent on condition assessment --what problems might be addressed in which crops).
  
4. Product Handling, People and Automation

- a. Field equipment automation for specific tasks (seeding, transplanting, harvesting) might be justified after careful survey of options, including system change and plant breeding, and examination of overseas technology.
- b. Product handling systems (picker -- belt), and ergonomics (improving the person/machine interface).

#### 5. Supplier/Developer Views and Comments from Growers

Each topic was attributed to a generic question that growers could openly answer. These questions also set the direction of what speakers would talk about in the discussions. The generic questions for each topic of the seminar are were as follows:

- 1) **Precise Technologies- The opportunities:** What technology can we expect to be using in the next 10 years? What adaptation/evaluation will be required?
- 2) **Precise Technology - The Impact:** What can we do with this technology to improve efficiency, productivity and sustainability in the field?
- 3) **Site Specific Agriculture:** How can we adapt this technology for horticulture? What are the new opportunities in horticulture?
- 4) **Product Handling, People, and Automation:** Labour pressure points. What are the realistic improvement opportunities in the next 10 years?
- 5) **Supplier/Developer Views and Comments from Growers:** What important mechanisation system topics have we missed?

### **Expected Outcomes:**

The discussions that followed from industry speakers were expected to serve as a spring board for growers to talk about their views on products and technologies and what relevance these would have to their operations and how effective they could be if they were applied. The views expressed in the seminar were expected to bridge the gap between what is often described as a gap between what researchers study and what developments

growers wish to see.

## **Products:**

After the seminar, the Vegetable IAC will have a reference paper to understand what mechanisation options growers are interested in for their farms. This reference guide would be able to be applied when assessing new mechanisation projects as they are considered by the Vegetable IAC and its subgroups.

## **Materials & Methods**

The methods for conducting the seminar are outlined below in the same format as it was proposed in the project submission:

- “1. Convene a seminar to bring together all relevant industry stakeholders, as well as selected Working Group, Advisory Group and Vegetable IAC members, to discuss opportunities and challenges in the area of mechanisation and precision agriculture for the vegetable industry. The workshop will be held on Thursday 14 April 2011 at the Sebel-Citigate Hotel in Brisbane. The Final Report, including detailed recommendations, will be submitted to HAL by 31 July 2011.
2. Invite participants, set an agenda, assemble papers and provide these to participants prior to the seminar, and organise the venue.
3. Liaise with participants to arrange flights, meals, and accommodation.
4. Develop seminar notes capturing discussions for future use.”

-VG10108 Project Proposal

- 1) The decision to convene the seminar in the lead up to the AUSVEG National Convention was deemed to be the most appropriate means of bringing seminar attendees together. A high number of attendees were going to be attending other industry meetings during the same period and this presented the most cost effective way of hosting the seminar, as well as ensuring a strong level of participation from experienced leaders.
- 2) The agenda was developed by an external service provider with extensive knowledge in this area. Controlled Traffic Farming Solutions (CTFS) and its principle consultant Dr Jeff Tullberg were engaged to prepare the agenda and prepare the briefing papers for the participants. Seminar participants were chosen under the criteria that they were vocal proponents of mechanisation within the industry, had mechanisation expertise in their field of study or had significant installations on their properties.

Attendees fell in to either of these categories. Consideration was also given to ensure growers from every state and growing region around the country were present at the seminar to avoid discussions were centralised around specific localities or growing conditions.

- 3) Having AUSVEG organise the logistical arrangements for the seminar was the most logical decision as it was already acting as the convenor of the seminar.
- 4) The briefing note prepared for all seminar attendees outlined the agenda for the event. This was written in consultation with Dr Jeff Tullberg and his plan on how to execute the seminar. AUSVEG acted as minute takers and a copy of the seminars minutes are attached to this report (Appendix 1).

## **Results**

The below excerpts are from the minutes of the seminar. The quoted sections are discussion points raised by growers expressing interest in areas growers would either like to see investigated or areas that they wish to see some outcomes achieved. These excerpts have been considered when formulating the recommendations for this report.

### **Grower Comments:**

**1)** Excerpt from Minutes: “It was commented that cost saving is a crucial area for everyone and it was said that there was enough work currently being done in precision agriculture and many products already on the market. An attendee noted that growers wanted research regarding automating labour as it was the most expensive input in their business. It was said that precision agriculture goes hand in hand with cost saving.”

Pg4

**2)** Excerpt from Minutes: “It was discussed that the main priority is automation in the field, such as harvesting and an increase in automation would also benefit the grower in the area of OH&S.”

Pg6

**3)** Excerpt from Minutes: “It was noted that the horticulture does not need extremely high precision so there is room to downgrade accuracy to increase affordability and speed.”

Pg6

**4)** Excerpt from Minutes: “A question was raised about extra skeletal robotics (exo-skeletons). It was said that the military are looking into it and it will definitely be happening.”

Pg6

**5)** Excerpt from Minutes: “A question was asked whether there was any development in glasses for colour blind workers, through using similar technology to sensing.”

Pg6

**6)** Excerpt from Minutes: “It was stated that what a grower needs and wants should be explored and a ‘wish list’ was suggested. It was said that research needs to be conducted to make an informed choice because not many growers in Australia have the ability to take the next step.”

Pg. 8

**7)** Excerpt from Minutes: “It was said that what interests growers in automation and mechanisation at the moment is: optical grading, physical harvester for lettuce, an interchangeable head for a field harvester for lettuce, broccoli and cauliflower and smaller tractors for smaller areas.”

Pg8

**8)** Excerpt from Minutes: “It was suggested that there be collaboration of systems that are already available and what is being done globally in other countries and bring it together for the horticulture industry in Australia.”

Pg9

**9)** Excerpt from Minutes: “It was noted that there were recent R&D projects looking at uniform crops because all the growers know how hard it is to get a face cut. It was said that crop standardisation should go forward if that is what is causing the problem.”

Pg9

**10)** Excerpt from Minutes: “It was said that information needs to be accessible to people who put prototypes of machines together. It was mentioned by a number of people in the meeting that there is a need for information accessibility via online resources”

Pg9

**11)** Excerpt from Minutes: “It was said that the point, harvesting was the issue and that’s where robotics and automation are needed. A scoping study was suggested, where four or five items would be selected as an initial start-up. It was said that with the four or five commodities, an investigation should take place where you observe the way things are harvested today and then look at what kind of automation can be applied to that.”

Pg9

**12)** Excerpt from Minutes: “It was said that tomatoes, cucumbers and capsicums are commodities that should be used as a scoping target for the project discussed as they are common and popular. It was said that at the moment they are all being handpicked and that there is no automation that is used for those crops.”

Pg10

## **Evaluation and Discussion:**

When asked, approximately 25 per cent of the seminar attendees said they were using precision technologies on their properties. While many growers understood that precision technologies were necessary for fully automated mechanical harvesters there was a consensus that there were many difficulties that could be attributed to problems such as crop standardisation that removed them from being able to fully pursue this course of action.

Based on the outcomes of the seminar there are a range of areas in which progress in automation and robotics in the horticulture industry can be made but it is evident that consultation with growers will need to be maintained in order to deliver commercial success from sales to growers.

The first scenario for the future of automation will be a continuation of the current trend where automation is applied in situations where high annual utilisation and a relatively controlled environment make it feasible and economic to use an industrial methodology. This means pack houses, nurseries and protected cropping environments. This will likely be confined to larger operations but robotics/automation consultants should become familiar with the industry in order to identify future directions and infield technology options. If the current trend remains the same, packhouses and processes off field will continue to be innovative but as a result of passed on innovations from the manufacturing and other production line intensive industries. In this case no substantial developments or infield breakthroughs will be developed in this country and new options will need to be sought from overseas.

Secondly, from domestic perspectives, companies such as Williames and Transplant Systems will continue to see opportunities and work on new technology requests from industry, using a mixture of mechanical ingenuity and electronics. These individual companies provide major benefits to the industry, but are likely to be resistant to bureaucratic assistance and loss of Intellectual Property (IP) through projects partly funded by industry. It's worth noting that the first application of high-precision guidance in agriculture was by a farmer-engineer-inventor in New South Wales. It's also worth noting that despite its huge advantages, and considerable initial investment from Australia the technology went overseas to be developed to the point where it's relatively cheap and commonly available on most tractors and machines. The same environment unfortunately applies to the current development environment. Given the comparative size of the Australian industry when compared to its overseas counterparts it is difficult to develop any technology through private enterprise without some contribution from industry, in which case, IP (and by extension competitive advantage) will be lost. Larger developments in technology, while



sometimes road tested in Australia due to the difficult conditions here are funded by large multinationals such as John Deere. These companies have accumulated the required capital to invest in privately funded R&D and will likely be the future source of any large breakthroughs as the process becomes more expensive.

Finally, the third scenario will be that Australian growers will resort to sourcing technology and mechanized options from overseas. Similarly to Australia, many European countries face high labour costs which drive the investment in technology. Additionally, these countries have a substantial farming base that can provide a reasonable Return on Investment (ROI) toward any new products (unlike Australia). It is plausible that the Australian development industry will reduce as its European counterparts are able to invest greater capital into projects. This has already been identified by many companies in Australia with several of these establishing offices or supplying products abroad.

The greatest challenges of field automation are now related to product variability in both size and positioning. This applies mainly to sensors and tools. These are the system issues addressed by spatial precision, which can reduce product variability by greater uniformity in soil conditions, input distribution and inter-plant spacing. It can also provide much better control of the relative positions of product, sensor and tools. It is important to note that permanent traffic lanes also reduce vibration, and smoother-surfaced, more uniform soil in permanent beds reduces the issue of dirt interference with sensors and tools. Precision transforms the field environment, overcoming some of the most difficult issues.

Grower concern about labour costs has often been the genesis of equipment R&D programs, but automated solutions can be expensive. The potato harvester is a well-known example where growers, confronted with the purchase cost of the automated unit, looked instead at what they could change in their own systems. The answer they found was precision – long before the development of a two centimetre autosteer.

The view shared by many informed people is that there are few mechanisation problems facing the vegetable industry that require fundamental research or new technological capacity. The individual components needed to address most issues are already in place, being used in other agricultural, horticultural or industrial situations. Innovation occurs when these components are adapted and brought together with cropping system changes in systems that fit local economics, but the risk of unintended consequences is large when matching multiple physical, biological and system components.

Recent Australian innovations thus owe more to individual enthusiasm than organisational policy. This applies regardless of whether they involve mechanical ingenuity (broccoli harvester) or technological sophistication (precision autosteer, auto-transplanting). In

either case, lack of local development and marketing resources often means that Australian development only reaches full potential when moved overseas.

## **Reccommendations:**

**1:** Provide a link to the web resources already available to growers through the AUSVEG website.

Referenced to several times during the course of the seminar that a double up of knowledge is a waste of levy funds many growers referenced that they are unaware of current research, particularly as many were not aware of the MARRS report before the seminar. Many large scale growers either have their own agronomists on staff or have accounts with Rural Service suppliers such as Landmark or Elders who visit their properties. The AUSVEG website has access to 1,100 research papers covering all topics in Horticulture. Any agronomist or grower is strongly encouraged to make use of the website so they can see the latest investments of the levy as projects are completed.

**2:** A catalogue of mechanised farming tools from around the globe be created to act as a point of reference for growers wishing to source technology not available in Australia.

There are several countries around the globe considered as pioneers in automation and harvesting technology and much of what has already been developed by these companies is unknown to growers in Australia. To avoid duplication of work by companies looking to develop domestic innovations and save growers time researching technology options a product catalogue to easily source new automated technologies should be created and made available on the AUSVEG website.

The catalogue would be a company directory that also provides information about what technology it specialises in and provide links to relevant pages on its website as well as contact details. Product categories would not just be limited to harvesters but also apply to scales, graders, mechanical arms and other machines used in packhouse operations.

**3:** A Scoping study be conducted on the five most popular lines of vegetables that do not yet have fully mechanised options available to them.

It was noted during the seminar that harvesting still poses a major problem for growers. It was suggested that a scoping study be selected as an initial start-up using the five most popular product lines to investigate the methods of harvesting by hand today and what can be done to automate those processes. Commodities such as potatoes and carrots would likely not be included as the harvesting aids already exist for these unless sufficient evidence was presented to justify having them included.

**4:** A survey of all grower attendees to be conducted to gather additional information about the level of mechanisation in their operations:

During the seminar it was difficult at times to build proper profiles of growers and note their activities on farm. As such, a debriefing evaluation form regarding what mechanisation tools growers already have in place/ wish to put in place/ wish to see pursued should be sent out to all attendees. This survey and its results would be beneficial to any domestic companies looking to create niche options for growers.

The questions asked might be:

- 1) What crops are grown on your property?
- 2) What mechanisation do you currently have in place on your property?
- 3) What mechanisation (invention/adaption) would help you on your property?
- 4) Do you have any unfinished projects on farm that need R&D funding to complete?
- 5) Should future investments be focused solely on the development of harvest aids such a vegetable picking machinery? Or is there benefit in branching out into further development of packhouse machinery such as mechanical arms or box makers?

## **Conclusion:**

Overall the seminar took the first step toward developing a foundation relationship between mechanisation developments and the growers that these tools are being designed to assist. Future investment decisions and R&D projects within the Australian Horticulture industry should use the perspectives contained within this document as a reference when justifying the need for new project research.

While it has been recommended that overseas sourcing of new technology should be used rather than Australia reinventing something that already exists, Australia still has a role to play in the design/concept stage. Either by adapting currently existing technologies to Australian conditions or designing a niche product that would be relevant only to the Australian environment, some domestic R&D will always be required in this country regardless of its funding source (either private or industry funded). These adaptations or designs are likely to be capital intensive and would require extensive consultation with growers that are likely to purchase the products. It is important that seminars such as the Mechanisation Seminar continue to be hosted to ensure any future design initiatives are properly in line with the expectations and requirements of the horticulture community.

## Appendices

1. April 2011 Mech sem minutes
2. 2011 Mechanisation Briefing Document and Agenda



## **Mechanisation Seminar: Meeting Outline and Briefing**

13<sup>TH</sup> April 2011 - Sebel-Citigate, Brisbane

The 2011 Mechanisation Seminar has been designed to assist the vegetable IAC and its subgroups towards optimal investment decisions for the benefit of Australian vegetable growers, by bringing together industry specialists from research and commercial fields along with prominent, forward-thinking growers representing all states.

The seminar focus is field mechanisation, recognising that this is the first step in the value chain ending with the consumer. It will also be concerned primarily with levy crops, without ignoring the presence of other crops in most growers' systems.

Major generic areas along with the possibilities and impact of spatial technology, including greater precision in the machine/crop relationship, improved sensing of soil/crop characteristics and automation will be discussed.

The seminar will be broken down into four topics;

- 1) Precise Technology – The Opportunities**
- 2) Precise Technology – The Impact**
- 3) Site-Specific Precision Agriculture**
- 4) Product Handling, People and Automation.**

Each session will be commenced by Lead speakers in each of these areas. Further presentations by growers and other specialists will continue through the forum's discussion. In all cases, the presentations will occupy less than half the time allocated to each area, ensuring ample time for general discussion and input from growers.

***The objective is to identify potential expenditure needs in Research and Development (R&D) in mechanisation systems for the Australian vegetable industry over the next 10 years.***

Over this period we can expect labour costs to dramatically increase and the availability of labour to decrease. Automation will increasingly enhance labour productivity, but fully autonomous robotic operations are unlikely to be common. Pressures from consumer and sustainability interests will continue to grow and drive the necessity for mechanisation investment.

The distinction between specific problems found by growers, as opposed to the issues identified by research providers, needs to be narrowed, leading to cooperative systems that act as a catalyst to industry development.



Discussions of this type cannot avoid referring to specific problems and research opportunities, but it's important to emphasise that the objective here is to identify the generic topics which justify research investment, rather than specific projects.

The final session will allow for a longer discussion about what can be done for the industry. The focus is on guiding R&D expenditure to ensure optimal impact on productivity, as well as reducing input and labour costs on farm.

Between now and the seminar in April, if you could apply your mind to mechanisation practices that are already in use on your farm, as well as identifying specific areas that you think need attention, it would be beneficial for the seminar as a whole.



## 2011 Mechanisation Seminar: Program Outline

### Venue:

King George Room, Level 2, Sebel-Citigate Hotel

### Time:

Wednesday 13 April 2011, 10:00am – 4:30pm

#### 9:45am – 10:00am:

Arrival – Morning Tea and Coffee

#### 10:00am – 10:10am:

Welcome and discussion of seminar objectives by seminar facilitator, Mr Tony Russell

#### 10:10am – 10:20am:

Introductions

#### 10:20am – 10:30am:

Agenda Overview

Initiator – William Churchill

Planner – Jeff Tullberg

Facilitator – Tony Russell

#### 10:30am – 11:15am:

##### **1) *Precise Technology – The Opportunities***

Speaker: John McPhee (TIAR)

General Question: What technology can we expect to be using in the next 10 years? What evaluation/adaptation is required?

#### 11:15am – 12:00pm:

##### **2) *Precise Technology – The Impact***

Speakers: Dr Don Yule (CTFS) and Mr Robert Hinrichsen (Kal Fresh)

General Question: What can we do with this technology to improve efficiency, productivity and sustainability in the field?





**1200pm – 12:45pm:**

**3) Site-Specific Agriculture**

Speakers: Dr Brett Whelan (ACPA) and Mr Troy Jensen (NCEA)

General Question: What can we do with this technology to improve efficiency, productivity and sustainability in the field?

**12:45pm – 1:45pm:**

Break for lunch.

**2:00pm – 2:45pm:**

**4) Product Handling, People and Automation**

Speakers: Mr Clyde Campbell (MARS) and Mr Ian Willert (Boomaroo Nurseries)

General Question: Labour pressure points. What are the realistic improvement opportunities in the next ten years?

**2:45pm – 3:10pm:**

**Supplier/Developer Views**

Speakers: Mr Kevin Platz (John Deere) and Mr Mark Bell (Transplant Systems)

General Question: How can we improve translation from grower needs and research to economic production technology?

**3:10pm – 3:30pm:**

Afternoon Tea

**3:30pm – 4:15pm**

Wrap-up and what's missing?

General Question: What important mechanisation topics have been missed?

**4:30pm-6:00pm**

*At the conclusion of the seminar complimentary drinks will be provided at the KG Bar, Sebel-Citigate.*



Know-how for Horticulture™

## Minutes: Mechanisation Seminar – 13 April 2011

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<b>Attendees:</b>	Michael Nixon Robert Kuzmicich Paul Shain Charlie Blogna David Ellement Luka Biocich Paul Gazzola Ian Willert Andrew Bulmer John Said Greg Spinks Mark Bell Theo Jacometti Tony Russell (facilitator and moderator of seminar) Mark Kable Andrew Craigie David Wishaw John McPhee Colin Houston Danny De Ieso Denise Kreymborg Rodney Emerick David De Paoli Matthew Hood Richard Gorman Robert Hinrichsen Kevin Platz Jeff Tullberg (Planner of seminar) Don Yule Ed Windley John Etty Jeff McSpedden Brett Whelan Clyde Campbell Troy Jensen Will Gordon (HAL) Kathryn Lee (HAL) David Moore (HAL) Ravi Hedge (HAL) Paul Vaughan Alan Rogers	<b>Venue:</b> Sebel-Citigate Hotel Cnr Roma and Ann Street Brisbane QLD 4000
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Guests

Courtney Burger (AUSVEG minutetaker)  
Lisa Higginson (AUSVEG minutetaker)

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**Apologies:** No apologies

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**Date:** Wednesday 13 April 2011

**Time:** 9.57am – 4.37pm

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**Meeting objectives** A range of speakers discussing the use of mechanisation in the vegetable industry.

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*AUSVEG CEO Richard Mulcahy, began the seminar at 9.57am*

The attendees were welcomed and a brief outline on the background to the event was given. Key industry members in the room were acknowledged and the seminar moderator Tony Russell was introduced.

*The moderator Tony Russell was welcomed on stage at 10.01am*

It was said that the aim of the seminar was to discuss where the Research and Development (R&D) funds need to be directed and allocated over the next five to 10 years in the fields of precision agriculture and automation.

Mechanisation was discussed as the main means of combating labour costs for long term investment. The moderator outlined the exponential potential of mechanisation in the horticulture industry.

*The moderator Tony Russell, welcomed the program planner Jeff Tullberg onto the stage at 10.07am*

The objective of the seminar was highlighted to not only present information but also obtain input from the attendees and share ideas around the room.

*The program planner Jeff Tullberg, welcomed the first speaker John McPhee (Tasmanian Institute of Agricultural Research (TIAR) onto the stage at 10.10am*

Opportunities that exist around precision technologies were mentioned as the topic's leading discussion point. It was said that precision technologies can give precise information and data resulting in accurate management of crops and resources.

The slideshow: "Precise Technologies – The Opportunities" was shown. Precision of machinery was discussed as a key element in better management input and as a way to increase dollar per hectare output. A show of hands for who was using precision technology was asked and about a quarter of the room raised their hands.

Factors that influence final yield and quality were listed as: Quality of seed and seedling, uniformity of seed and seedling and placement during sowing and transplanting.

It was said that the grain industry has a longer history of monitoring and imagery than the vegetable industry; however, yield monitoring is useful for data planning and management. GNSS Satellites were mentioned and crop monitoring using spatially referenced imagery was highlighted.

*The next speaker, Troy Jensen (from the National Centre for Engineering in Agriculture (NCEA), was welcomed on stage at 10.14am*

Remote sensing was defined as the ability to measure the properties of an object or area without making physical contact with the object and can be achieved through the use of satellites and aircraft. It was highlighted that in most applications of remote sensing, electromagnetic radiation is utilised to sense the properties of an object or area.

Spatial, spectral, temporal and radiometric solutions were mentioned as factors able to be gauged by sensing. It was mentioned there are advances being made in refining the resolution of some satellite images to as low as 0.62 metres.

Thermal radiation was discussed as using infrared technology, which has a better sensing ability than the human eye. The slide: 'Comparison of Imagery Sources' was shown.

*Speaker John McPhee returned to the stage at 10.20am*

Data from real time decisions was given as an example of an innovation that is on the market but not widely used. It was highlighted that there are commercial products available on the market with the capacity to indicate the specific role of a machine and its performance. The possibility of loading new jobs and tasks from the office to the tractor was noted as giving the opportunity for more communication between operator and equipment.

Future features were noted as: monitoring of machine components for service prediction and a part replacement warning system. The implementation of vision guidance systems makes it possible to achieve finer levels of precision and intra-row operation that provides the capacity to do things other than weeding, precision seeding and controlled traffic. Implement guidance was noted as having practical benefits and vision guidance was discussed in relation to satellite guidance as having one centimetre accuracy.

The benefits were said to be lower energy consumption and reduced GHG (Green House Gas) emissions.

Issues for controlled traffic were listed as: equipment integration with compatible track and working width, machine tracking and stability and tracking stability for controlled traffic.

Mechanisation opportunities were said to be: strip tillage, spray based strip seeding, strip transplanting and zero-till. The culmination of these cost savings meaning lower input costs.

Standard essentials to mechanisation were noted to be available within the local industry and at a global level, which allows the development of Controlled Traffic Farming (CTF) systems and better integration.

*The moderator Tony Russell returned to the stage at 10.31am*

The advantages of precision technologies were discussed. Questions were raised as to whether the vegetable industry is capturing its full potential; and what R&D needs to be completed in order to adapt the technologies from other sectors.

It was commented that cost saving is a crucial area for everyone and it was said that there was enough work currently being done in precision agriculture and many products already on the market. An attendee noted that growers wanted research regarding automating labour as it was the most expensive input in their business. It was said that precision agriculture goes hand in hand with cost saving.

*The next speaker, Dr Don Yule (CTF Solutions), was welcomed on stage at 10.44am*

The speaker listed technologies that interact and work together as: RTK Positioning, telecommunications (including open access, community service, RTK signal by radio, Wi-Fi, Bluetooth, computer to computer, real time, remote inputs and controls, data downloads), crop sensing ("Measure to Manage" - It was said this would explain how your crop is growing and that it can measure machinery, management performance and can measure crop variability caused by growers) and yield mapping.

The speaker discussed the triple bottom line impacts of these technologies and demonstrated their ability to save money on farm.

It was discussed that integrated solutions can achieve: best processing practices, a dynamic community and integrated industry-wide implemented solutions. The slide: 'Triple Bottom Line Impact' was shown and an explanation of CTF System in grain was given.

*The next speaker, Robert Hinrichsen from Kalfresh, was welcomed on stage at 11.02am*

The speaker discussed that growers can control traffic when implementing precision agriculture and also mentioned the cost benefits. The evolution of technology with tractors was discussed and it was noted that boundaries can be pushed in the industry with precision agriculture.

Climate change was discussed in extreme cases from suffering from very dry conditions to wet within a short period and the impact this has on adjusting machinery to adapt to these changes. The benefits of downsizing the physical size of tractors while retaining the horsepower were discussed.

*The next speaker, Brett Whelan, was welcomed on stage at 11:15am*

Site-specific crop management was discussed and it was said that maps do not have to come from satellites they can come from sensors from the crops. It was said quality and quantity of crops can be managed through this type of management and using automated sensing techniques will save time and money.

Global navigation satellite systems (GNSS) for vehicle navigation and controlled traffic farming were explained and information of spatial and temporal variation was given.

It was stated that the bottom line to vegetable businesses comes from the variability of the production. It was said by managing the quality, it is possible to increase profit and save time. Optimising 'uniform-rate' crop management was discussed, as well as determining the magnitude, extent and responsiveness of spatial and temporal variability.

The potential adjustments to management strategies were mentioned to be readjustment of yield goals, either uniform or spatially variable. It was discussed that nutrient replacement based on a sound understanding of spatial variability is a concept to see if there are any differences in yield potential between fields that are used. It was said that each crop needs to be investigated for potential benefits because some crops will suit full-scale traditional SSCM (high value products and/or input a significant percentage of input costs). The general strategy for using information in SSCM was said to optimise uniform-rate crop management and determining variability.

It was suggested that yield monitoring be put on mechanical harvesters to increase mechanisation. It was noted that it would be beneficial to understand the major causes of any spatial variability in yield and quality. Mapping variability in soil and crop nutrients (directed sampling and crop reflectance sensors will prove useful now) was also suggested.

*The moderator Tony Russell returned to the stage and adjourned the seminar at 11.33am*

*The seminar recommenced when the next speaker, Clyde Campbell, came on stage at 11.55am*

It was discussed that in terms of automotives there have been a lot of changes and that the automotive industry is a good driver of technology change. A video clip was shown on how automation was used in building cars. Japan, China and Europe were mentioned as the leaders in automation on a world-wide scale. Availability of labour, cost of manufacture, improved quality, OH&S Risk management and international competitive edge were noted as the five key areas of introducing automation.

It was said that technology is bringing benefits to industries around the world, however, it was stated such technology and automation is not present in the vegetable industry. It was noted that the market is changing a lot quicker than the manufacturers want it to.

Another video was shown displaying the automation progression of the last four decades. It was stated that every robot is PC based and the industry needs to be improved because the next

generation will expect high levels on technology, such as touch screens etc. It was said that automation success was related to the meat industry and the benefit of the automation use was to pick up yield. However, it was mentioned that not everything should be automated; rather, it is important to choose the targets.

A short video of pineapple labelling was shown and mobile robotics were mentioned in regards to chilled vans and bin cleaning vehicles.

*The moderator Tony Russell returned to the stage at 12.18pm*

It was discussed that the main priority is automation in the field, such as harvesting and an increase in automation would also benefit the grower in the area of OH&S.

A question was raised regarding the impact of automated systems on a process, the ability of the robotics and what the associated costs would be to a business. It was said the cost of the robot depends on how fast tasks need to be completed and how heavy the load is. It was said the robot will not 'wear and tear' and that there have been robots that run for 24 hours a day for 15 years and in that time the cost of the robot would have paid itself off many times over.

A question was raised in regards to whether weather proofing has been developed for large machinery. It was noted that there has been some development and that the robotic companies are now looking at where their next big market is and food is such a growth area for them. Therefore they will develop according to needs. It was noted that the horticulture does not need extremely high precision so there is room to downgrade accuracy to increase affordability and speed. It was noted that stainless steel robots are fine to leave outside and you can wash them down.

A question was raised about extra skeletal robotics. It was said that the military are looking into it and it will definitely be happening. An example was given that the military have suits that you can wear and allows you to run around with a couple of hundred kilos on your back, however, they are quite expensive.

In relation to sensing, it was stated that density checking can be done and that there are benefits for the industry and a question was raised as to what major competitors and R&D should be doing.

A question was asked whether there was any development in glasses for colour blind workers, through using similar technology to sensing. It was noted that this could be something for the future and anything is possible because technology is moving so fast.

It was noted that the industry needs to set projects which create synergy between mechanisation and precision agriculture. It was said the horticulture industry is a low value industry in comparison to the red meat industry. A question was raised as to whether it is a realistically affordable option for the horticulture industry.

It was asked if solar energy technology has the ability to kill weeds.

The greatest cost in mechanisation was debated, whether it was: the cost of the physical robot machinery, the programming, upkeep or training.

*The next speaker, Jeff McSpedden, was welcomed on stage at 12.48pm*

It was said it is a possibility to do R&D projects on topics that had been mentioned. An example was given to look into covering seeds with clay to make them round shaped and therefore easier to be processed by the machines. Beetroot seeds were noted as a very difficult seed to handle with mechanisation.

It was encouraged that over lunch attendees should generate questions for the second half of the seminar. It was said that this meeting was a good forum for discussion because growers who work in the industry have the opportunity to speak to people that deal with the technology aspect of things.

*The seminar stopped for a lunchbreak at 12.52pm*

*The seminar recommenced when the next speaker, Ian Willert, came on stage at 1.59pm*

It was stated that Boomaroo Nurseries realised they needed to change the way things operated. It was noted that including automation in the company should not be seen as an obstacle but as a challenge and commitment to automation was highlighted as a key factor of success.

Although initially quite hard for Boomaroo to adopt automation, in recent times the benefits have been very noticeable. It was said that the automation in the company has safety systems built into them. It was said it is able to notice when someone is walking close and the machine will automatically shut down, however, won't shut down if it's raining. That it is these types of progressions that allow the company to move forward.

It was said that an area that might be able to be concentrated on is to put robotics into packing houses and removing the labour to minimise costs long-term. At the moment, Boomaroo Nurseries is having problems with fungus and diseases and to fight this they used a machine to blow water off the leaves.

*The moderator Tony Russell returned to the stage at 2.22pm*

Questions and comments were invited from the attendees and it was said that the IAC can drive the direction of where the need is and get the applications sorted out so automation can be used in the industry.

There were no questions raised.

*The next speaker, Kevin Platz (John Deere Tractors), was welcomed on stage at 2.26pm*

It was said that what initiated the categories is the different types of machinery in each area. It was said that there are so many aspects that can go into developing a product, for example, people, logistics etc. It was mentioned that John Deere supplies a certain amount of technologies to the industry as well as equipment to the industry. It was noted that John Deere spends \$450 million on R&D and the money is put towards predicting what is going to change in agriculture for the next 10-15 years.



*The next speaker, Mark Bell (Transplant Systems), was welcomed on stage at 2.34pm*

It was said that Transplant Systems' focus on working closely with your seedling provider was critical in order to see the best results. It was suggested that growers need to be trained in order to understand the machines and then develop the product therefore enabling efficiency.

The vegetation unit was discussed, stating that these machines are able to grind into the ground in order to plant in difficult circumstances. It was said that there is a self-powered unit that is operational in Europe at the moment but these can only be used on flat ground.

A question was raised about planting in plastic moulds. It was said that Transplant Systems don't have a system to plant through plastic because this method is unviable at the moment in terms of efficiency and there haven't been many requests for this.

*The moderator Tony Russell invited questions and open discussion from the attendees at 2.47pm*

It was raised by attendees that there was a hope to learn more about robotics. It was said that one of the expected outcomes was to see if the industry could pull together to save labour costs. A question was raised as to how many robotic companies there are in Australia and what size robotics is available. It was said that it was good to hear about how every other company is using automation, however, a method going forward was wanted.

It was raised that duplication of research is not acceptable and neither is waste. It was said that big money was put into the report by MARRS and all the technologies were explored but information needs to get out to growers because they pay the levy and therefore they need to see the information. It was confirmed that the report that holds all the robotics information was all in the document. It was said that one of the findings of the report was to develop a cooperative research centre.

It was said that the mechanisation seminar was a genuine attempt to highlight what is available to the industry. It was said that it is not up to Horticulture Australia Limited (HAL) nor is it up to industry funds to determine other people or company's problems. It was said that the finger can't be pointed at other industry members and growers need to take the next step and decide what is best for them and their companies.

It was stated that what a grower needs and wants should be explored and a 'wish list' was suggested. It was said that research needs to be conducted to make an informed choice because not many growers in Australia have the ability to take the next step.

It was said that what interests growers in automation and mechanisation at the moment is: optical grading, physical harvester for lettuce, an interchangeable head for a field harvester for lettuce, broccoli and cauliflower and smaller tractors for smaller areas. It was said that there needs to be cooperation and information sharing between businesses. It was suggested that if everyone puts in their ideas there could be a prize for participants that design one type of machine that would be beneficial to everyone.

It was suggested that there be collaboration of systems that are already available and what is being done globally in other countries and bring it together for the horticulture industry in Australia. It was discussed that if something isn't done now, in 10 years time nothing will have changed. It was said that it's not something that is forced upon anyone in the short or the long term, however, something needs to be decided on now.

*The seminar stopped for afternoon tea at 3.27pm*

*Grower discussions recommenced at 3.54pm*

A question was raised as to why a lettuce harvester has been created and why certain harvesters have not been built. It was said HAL and AUSVEG need to identify what the issues are. It was noted that there were recent R&D projects looking at uniform crops because all the growers know how hard it is to get a face cut. It was said that crop standardisation should go forward if that is what is causing the problem.

It was said that information needs to be accessible to people who put prototypes of machines together. It was mentioned by a number of people in the meeting that there is a need for information accessibility via online resources. It was suggested to distribute a roll call to see who attended the mechanisation seminar so that networking would be made easier.

<p><b>ACTION (1):</b> It was agreed that names and contact details of attendees of the mechanisation seminar be distributed.</p>
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The issue of fuel prices was raised and how this would affect automation and robotics. It was said that collation of information needs to be accessible so that it can be taken back and modified. It was said that sharing equipment will not work, especially with larger companies. It was encouraged by the moderator that it should be discussed where growers and industry members as to where they think the money should be invested. There was agreement with making information available to growers.

It was said that the point, harvesting was the issue and that's where robotics and automation are needed. A scoping study was suggested, where four or five items would be selected as an initial start-up. It was said that with the four or five commodities, an investigation should take place where you observe the way things are harvested today and then look at what kind of automation can be applied to that.

It was said that realistically the IAC cannot fund a machine but it can in fact fund R&D projects. It was stated that gaining automation for things like harvesting would be a positive and if automation and robotics aren't properly researched and developed, Australia will not be able to compete on an international scale. It was said that work has been done on harvesting broccoli with robotics. It was said that people have to be prepared for a high risk of failure.

Growers were asked if they thought it was a waste of time to go down the path of mechanisation and exploring whether robotics will reduce the labour costs at the harvest stage. No attendees supported this view.

It was said that tomatoes, cucumbers and capsicums are commodities that should be used as a scoping target for the project discussed as they are common and popular. It was said that at the moment they are all being handpicked and that there is no automation that is used for those crops.

**ACTION (2):** It was agreed that the MARRS report on automation be distributed to all attendees.

The moderator Tony Russell thanked all attendees for coming to the seminar and contributing to the discussions.

*The seminar concluded at 4:37pm*