Future Technologies Seminar

Richard Mulcahy
AUSVEG Ltd

Project Number: VG11024

VG11024

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HAL

Horticulture Australia

Future Technologies Seminar

Mr Richard Mulcahy
AUSVEG

Project Number: VG11024 (15/01/2012 – 31/07/2012)

VG11024

Future Technologies Seminar

15/01/2012 – 31/07/2012

FINAL REPORT

AUSVEG

HAL

Horticulture Australia

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Purpose of Report: The purpose of this report is to provide feedback and recommendations from growers on their view of the benefits of the potential future technologies outlined during this seminar, particularly on the potential use of these technologies in the future by the Australian 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 investment decisions in regards to future technologies.

As outlined in the project proposal, the seminar was planned as a result of a request made by the Vegetable IAC and its subsequent advisory groups in 2011. While the seminar was originally put forward as a project definition by an advisory group in 2011, it has since been identified that the area of future technologies in the vegetable industry is a key strategic priority.

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101	15/01/2012	Agreement signed, voluntary contributions (if required) received and IP arrangements in place
190	**31/07/2012**	**Final report received by Horticulture Australia Ltd**

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1. Media Summary

The Future Technologies Seminar was held on Wednesday 9 May 2012 at the Wrest Point Hotel Casino in Hobart. The seminar brought together 34 growers to discuss their opinions on the major future technologies, as requested by the Vegetable IAC, to benefit the Australian vegetable industry in the next 10 to 20 years. The event also served as an opportunity for the speakers to identify future innovations or modifications to their product range which can help benefit growers. As such, the seminar promoted open dialogue between researchers, growers and industry service providers to identify what technologies growers desire to see implemented on their farms.

The key insight from the seminar was that growers desire a more open relationship with the researchers/ developers of farming technologies. Enhanced dialogue would facilitate a better understanding and more precise knowledge of what is required and desired by growers, and what is achievable by researchers/ developers. Ultimately greater cooperation will result in more appropriate and useful technologies being developed.

A major outcome of the seminar was constructive ideas for future research and development funding within the industry, and an increased awareness of potentially useful technologies for farmers that were already available but not widely known.

The development of the future technologies outlined during the seminar should be monitored by industry. The growers in attendance at the seminar, as well as IAC committee members, HAL and AUSVEG representatives will play a vital role in monitoring the progress of these technologies, particularly in heightening awareness across industry.

2. Introduction

The development of technologies beneficial to the Australian vegetable production industry has become an urgent priority. Due to rising input costs, increasing labour costs and a decrease in available workers, technologies which can improve productivity and reduce financial burdens are highly desired. The Future Technologies Seminar was put together to address these issues as a result of discussions held in the Vegetable IAC and the Working and Advisory Groups throughout 2011.

The objectives of this project (VG11024) were to identify the opportunities and limitations of these technologies in an Australian setting, and to provide a vision of how the vegetable industry will operate in the future. It is expected that as a result of the collaboration between growers, supply chain members and researchers, these technologies will be improved and adapted to be made more effective.

The primary objective of the seminar was to identify how future technologies can reduce the cost of labour, increase profitability through yield and waste management, and explore methods of addressing the rapidly increasing global population. The potential future technologies discussed at the seminar included well-documented technologies such as genetic modification and mechanical innovations, but also introduced lesser known innovations such as nanotechnology, microwave radiation technology and advanced robotics.

The scope of the seminar was not specifically limited to vegetable growers and included any activity with the potential to reduce costs throughout the vegetable production chain. Due to problems encountered in the past in relation to the Australian market accessing technologies developed internationally, all speakers at the seminar were based in Australia or New Zealand with their research intended for application in Australia. The agenda also included the opportunity to address the difficulties in applying technologies on farm, including the implementation of new technologies and the effect this can have on business processes. The availability, profitability and implementation of the new technologies have been identified as key issues.

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

The seminar was not intended to focus on one particular innovative technology, but to outline multiple new technologies that may be made available to Australian growers in the next 10 to 20 years. The technologies were presented in a ‘paddock-to-plate’ format, so as to provide insight into the potential developments across all aspects of the vegetable

production chain. As a result, the seminar had a wide appeal – something for all the attendees.

3. Future Technologies Seminar Delegate List

Key Speakers

Name	Organisation
Sam Birrell	Netafim
Graham Brodie	University of Melbourne
Thambaramala Gamage	CSIRO
Roger Hellens	Plant & Food Research New Zealand
Kevin Platz	John Deere Australia
Salah Sukkarieh	University of Sydney
Terry Turney	Monash University

Guests

Name	Region	Category	Organisation
James Fagan	Cowra NSW	Grower	Mulyan
Jeff McSpedden	Bathurst NSW	Grower	JW & FJ McSpedden
Mark Napper	Mona Vale NSW	Grower	
Peter Ward	Upper Colo NSW	Grower	
Linton Brimblecombe	Forest Hill QLD	Grower	Moira Farming
Melinda Brimblecombe	Forest Hill QLD	Grower	Moira Farming
Rodney Emerick	Bowen QLD	Grower	Mulgowie Farms
Richard Gorman	Kalbar QLD	Grower	Kalfresh
Robert Hinrichsen	Kalbar QLD	Grower	Kalfresh
Matthew Hood	Gatton QLD	Grower	Rugby Farms
Steve Newman	Gumeracha SA	Grower	Hills Fresh
David Addison	Moriarty TAS	Grower	
Neil Armstrong	Forth TAS	Grower	Harvest Moon
Kevin Clayton-Greene	Forth TAS	Grower	Harvest Moon
Lawrence Cowley	Cambridge TAS	Grower	Houstons Farm
Andrew Craigie	La Trobe TAS	Grower	
Anthony Houston	Cambridge TAS	Grower	Houstons Farm
Mark Kable	Forth TAS	Grower	Harvest Moon
David Whishaw	Carrick TAS	Grower	

Andrew Bulmer	Lindenow VIC	Grower	Bulmer FarmFresh
Peter Cochrane	Devon Meadows VIC	Grower	PJ&J Cochrane
Luis Gazzola	Somerville VIC	Grower	Gazzola Farms
Andrew Fragapane	Werribee South VIC	Grower	Fragapane Farms
Russell Lamattina	Boneo VIC	Grower	Lamattina & Sons
Tina Lamattina	Boneo VIC	Grower	Lamattina & Sons
Robert Nave	Werribee South VIC	Grower	Fragapane Farms
Frank Ruffo	Bacchus Marsh VIC	Grower	Tripod Farms
Frankie Ruffo	Bacchus Marsh VIC	Grower	Tripod Farms
Daniela Ruffo	Bacchus Marsh VIC	Grower	Tripod Farms
Angela Ruffo	Bacchus Marsh VIC	Grower	Tripod Farms
John Said	Werribee VIC	Grower	Fresh Select
Grayson White	St Kilda VIC	Grower	Butler Market Gardens
Paul Bogdanich	Woodvale WA	Grower	
Michael Nixon	Carnarvon WA	Grower	Riverlodge Assets

Observers/ Other

Name	**Organisation**
Will Gordon	Horticulture Australia
Ravi Hedge	Horticulture Australia
Kathryn Lee	Horticulture Australia
Peter Hockings	BFVG
Denise Kreymbourg	BDGA
Richard Mulcahy	AUSVEG
Hugh Gurney	AUSVEG
Ryan Leonard	AUSVEG
Christopher Ritchie	AUSVEG
Jeremy Story Carter	AUSVEG

4. Seminar Details

The seminar comprised eight presentations, seven of which outlined potential technological innovations to benefit the Australian vegetable grower. The eighth presentations outlined the farmer/ grower's perspective of what is technologically required.

Presentation topics were outlined in the seminar briefing document circulated to all attendees in the fortnight prior to the event (**APPENDIX 1**). The briefing document also contained the seminar agenda as well as the list of speakers and the generic questions asked of the growers. Additionally, AUSVEG put out a media release on 3 May 2012 advertising the upcoming event. The release generated print and radio coverage (**APPENDIX 3**).

To facilitate discussion, 15 minutes was allocated at the end of each of the presentations in which attendees could question the key speakers. To supplement this discussion, two panel discussions took place at the end of the morning and afternoon session which lasted for 15 minutes, and enabled a greater degree of interaction between the speakers and the audience on broader issues.

The topics that were covered throughout the seminar were as follows:

MORNING SESSION

1. Future Challenges for the vegetable industry – Mr Jeff McSpedden (Vegetable IAC) The grower's perspective.
2. Genetic Modification – Dr Roger Hellens (Plant & Food Research New Zealand).
3. Nanotechnology – Dr Terry Turney (Monash University).
4. Processing Innovations – Dr Thambaramala Gamage (CSIRO).

Panel Discussion A

- Mr Jeff McSpedden (Vegetable IAC).
- Dr Roger Hellens (Plant & Food Research New Zealand).
- Dr Terry Turney (Monash University).
- Dr Thambaramala Gamage (CSIRO).

AFTERNOON SESSION

5. Microwave Technology – Dr Graham Brodie (University of Melbourne).
6. Irrigation Innovations – Mr Sam Birrell (Netafim).
7. Crop Harvesting Innovations – Mr Kevin Platz (John Deere).
8. Robotics in Agriculture – Mr Salah Sukkarieh (University of Sydney).

Panel Discussion B

- Dr Graham Brodie (University of Melbourne).
- Mr Sam Birrell (Netafim).
- Mr Kevin Platz (John Deere).
- Mr Salah Sukkarieh (University of Sydney).

Each topic was allocated 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) **Future Challenges for the Vegetable Industry**
   Q. What are the challenges and issues vegetable growers are set to face in Australia within the next 10 to 20 years?

2) **Genetic Modification**
   Q. How can the development of genetic modification technology help to address some of the challenges set to face vegetable growers in Australia over the next 10 to 20 years?

3) **Nanotechnology**
   Q. How can the development of nanotechnology help to address some of the challenges set to face vegetable growers in Australia over the next 10 to 20 years?

4) **Processing Innovations**
   Q. How can the development of processing innovations such as plasma screening help to address some of the challenges set to face vegetable growers in Australia of the next 10 to 20 years?

5) **Microwave Technology**
   Q. How can the development of microwave technology in relation to the removal and prevention of weeds help to address some of the challenges set to face vegetable growers in Australia over the next 10 to 20 years?

6) **Irrigation Innovations**
   Q. How can the development of irrigation technologies and techniques help to address some of the challenges set to face vegetable growers in Australia over the next 10 to 20 years?

7) **Crop Harvesting Innovations**
   Q. How can the development of crop harvesting technologies and techniques help to address some of the challenges set to face vegetable growers in Australia over the next 10 to 20 years?

8) **Robotics in Agriculture**
   Q. How can the development and institution of agricultural robotics help to address some of the challenges set to face vegetable growers in Australia over the next 10 to 20 years?

Slides from the presentations are attached to this report (**APPENDIX 4**).

5. Expected Outcomes

The discussions that followed the key speakers were expected to serve as a springboard for growers to:

- talk about their views on products and technologies,
- discuss the relevance that the technologies would have for their operations, and
- illuminate how effective the technologies could be if they were applied.

The views expressed in the seminar were expected to bridge the gap between what researchers study and what developments growers wish to see. It was also hoped that these discussions would have ramifications for the way in which the speakers tailored their ongoing research in order to make it suitable for grower's needs.

6. Products

The seminar will be used by the Vegetable IAC as a reference point to understand what future technological options growers are interested in for their farms. Furthermore, the information gleaned from this seminar will provide invaluable advice for industry as it assesses new projects in relation to future technologies and developing innovations.

Importantly, industry needs to remain competitive and innovative in the future, particularly given ongoing hardships such as rising input costs, high labour costs, competition from cheap foreign imports, increasing taxes and regulations, and the requirement to be climate friendly and sustainable. Through time and financial investments in future technologies and innovation, the industry can help alleviate many of its hardships.

7. 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 areas of genetic modification, mechanisation and precision agriculture for the vegetable industry. The workshop will be held on Wednesday 9 May at Wrest Point Hotel-Casino. The Final Report, including detailed recommendations, will be submitted to HAL by 31 July 2011.

2. Consult the IAC sub-committee constructed to oversee this project in regards to their opinions on the key elements to be included in the seminar.

3. Present recommendations to IAC sub-committee for review.

4. Invite participants, set an agenda, assemble papers and provide these to participants prior to the seminar, and organise the venue.

5. Liaise with participants to arrange flights, meals, accommodation and other logistics.

6. Develop seminar notes capturing discussions for future use.

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.

The agenda was developed internally by AUSVEG who consulted the Vegetable IAC committee members who oversaw the project. The participants chosen for attendance at the seminar were leading growers throughout each state in Australia. It was decided that having representatives from the leading farms across Australia would result in the most beneficial discussion for the entire industry from both the growers' and researchers' perspective. Additionally, leading growers tend to be active and open in sharing findings and disseminating insights with their colleagues and co-workers, which benefits the wider industry. Consideration was also given to promote a geographically diverse audience, that is, growers from each state and growing region around the country. This helped ensure that discussions were not state-centric or solely focused on a specific set of growing conditions.

Given that AUSVEG was hosting its National Convention and convening other seminars, workshops and meetings during the week, the Peak Industry Body was well placed to organise the logistical arrangements for the Future Technologies Seminar, and host the event.

The briefing note prepared for all seminar attendees outlined the agenda for the event. This was written in consultation with the Vegetable IAC members and took into consideration their advice on the objectives and outcomes of the event. AUSVEG acted as minute takers and a copy of the seminar minutes are attached to this report (**APPENDIX 2**).

8. Results

The results of the Future Technologies Seminar can be ascertained through analysis of the feedback forms that were completed by attendees. These forms asked the attendees to outline their opinion, not only on the event itself, but of each of the key presenters. Participant ratings for each of the speakers are attached to this report (**APPENDIX 5**).

Analysis of these feedback forms provides valuable insight into participant appreciation of the day. Below are some statistics that AUSVEG has extracted from the forms:

- 100% of attendees stated that their participation in this event was worthwhile.
- 96% of attendees stated that they would like to see further levy funded future technologies seminars.
- 100% of attendees stated that there were ideas presented that they could apply to their farm or business now or in the future.

This reveals that the seminar could be used by the levy governing bodies such as Horticulture Australia and the Vegetable IAC as a reference when discussing potential research and development projects. Consequently, the key objective of the event came to fruition.

Additionally, analysis of the feedback forms shows that the event was of enormous value to the attendees. Comments from both the researchers and growers reveal that the technologies discussed warrant further consideration and examination by industry.

The below excerpts are from the minutes taken during the seminar. Comments from researchers reveal the potential of the technologies, while comments from the growers reveal areas of interest, particularly what they would like to see investigated or achieved.

Researcher Comments:

1: Excerpt from Minutes: "It was raised by the Chair that preparation books focusing on how to maintain nutrients would potentially be beneficial to the industry."

-Page 1

2: Excerpt from Minutes: "It was said that dwarfing rootstocks could increase water efficiencies in horticulture."

-Page 2

3: Excerpt from Minutes: "Dr Hellens discussed minor allele variation within plants and said this was due to the different layers of a plant. He mentioned that this variation could allow for greater genetic diversity and potentially help to develop disease resistant strains."

-Page 2

4: Excerpt from Minutes: “Dr Turney said that nanotechnology would allow for sensors to become much more affordable and disposable in nature.”

-Page 3

5: Excerpt from Minutes: “It was explained that packaging was an area where nanotechnology had been used for a while and that packaging could be embedded with intelligent technology and that this could examine the suitability of a product to eat. Active packaging was discussed and it was noted that this technology could be used to allow vegetable produce to create its own atmosphere. Breathable film technology was highlighted as a way of controlling ripening processes and fungal attack. This technology was said to allow control of the ripening hormone ethylene and reduce it to a level where produce life could be greatly improved.”

-Page 3

6: Excerpt from Minutes: “Controlled release and scrubbing were discussed by Dr Turney and this technology was said to be employable to release or trap bioactive materials. Nano sized particles could be used to clean contaminated water or remove imbalances in phosphates.”

-Page 4

7: Excerpt from Minutes: “Enhanced plant growth was said to be another field where nanotechnology could potentially be used within agriculture. Dr Turney said that the safety of this technology was not yet known, but that it was fascinating and allowed plants to grow faster using less water.”

-Page 4

8: Excerpt from Minutes: “It was said that soils could be fortified with micronutrients and that these could be taken up by the plant. These plants have the potential to be marketed in a different way to be more beneficial to consumers.”

-Page 4

9: Excerpt from Minutes: “Cool plasma was outlined as a gas at 30-60 degrees and charged with ions. This can be used to treat seeds for surfaces. This technology is used in medicine to treat wounds and could be used to disinfect seeds. Cool plasma can also be used to treat for microbial inactivation and was said to leave no chemical residue and involve minimal surface alteration.”

-Page 4

10: Excerpt from Minutes: "Ultrasonic processing was discussed and it was said to cause bubbles in water to release large amounts of energy and pressure. It was also described as a method to pre-treat a number of plant fibres, including potatoes, reducing the amount of oil taken up in frying and also improving the crisping of these products."

-Page 4

11: Excerpt from Minutes: "It was said that these technologies could be used to take beneficial compounds out of waste streams and reuse them, thus improving efficiency."

-Page 4

12: Excerpt from Minutes: "Dr Brodie gave the example of a microwave treatment of weeds, and showed a video of the treatment of killing a weed. He continued, outlining the horn antenna as a way of projecting microwave energy. He described how the microwave continued through the soil to damage roots. Dr Brodie showed how microwave treatment caused plant stems to heat up from the inside. He continued, showing how a plant which had been treated by microwave as a result it could not remain alive."

-Page 6

13: Excerpt from Minutes: "Dr Brodie played a video from *Mythbusters* which outlined exploding water as a result of microwave treatments, then drew analogies between this and the microwave treatment of plants, highlighting how this treatment would destroy these plants."

-Page 6

14: Excerpt from Minutes: "Microwave treatment was also shown to affect the levels of bacteria in soil, with greater treatment levels decreasing bacteria levels."

-Page 6

15: Excerpt from Minutes: "The cost of labour was said to be a major issue for farmers and Sam gave an outline of how quick recoil irrigation technology could dramatically increase efficiency and reduce labour costs."

-Page 7

16: Excerpt from Minutes: "Low flow dripper technology was said to be important as it allowed for water to be applied to crops in a very slow way, which improves the health and yield of a number of plants. A flow on benefit of this was that it would allow energy to be used in a more efficient way."

-Page 7

17: Excerpt from Minutes: “Another project was shown using automation of mining technology. The large cost problem with mines was said to be that of labour, so autonomous trucks and machinery had helped to cut these costs.”

-Page 8

18: Excerpt from Minutes: “It was said that the key areas for this work were: sensors, rich representations, probabilistic models and data fusion and mapping. It noted that it was important that a robot could identify objects in the field. One such example was a robot that could identify a weed as opposed to a desired plant in a crop. There were said to be a large number of people experimenting in this field and that automation is not the only benefit, there are a number of additional benefits which can be seen as a flow on from these advancements.”

-Page 8

Grower Comments:

1: Excerpt from Minutes: “A question was asked in regards to the removal of broad spectrum chemicals currently in use by the Australian vegetable industry. It was said that maintaining a chemical which can destroy GM (genetically modified) plants which become a weed will be necessary. It was said that if the changes brought by GM were minor and beneficial, it should be supported.”

-Page 1

2: Excerpt from Minutes: “A question was asked about which of the technologies shown in the presentation were closest to commercial use. The answer was given that PSA resistance in kiwifruit was something which will be used in the very near future. It was said that a lot of these technologies were being used right now.” (In regards to genetic modification)

-Page 2

3: Excerpt from Minutes: “The Chair asked how many people were aware of the GM work that had been done in potato crops and only two people indicated that they were aware of this research.”

-Page 3

4: Excerpt from Minutes: “A question was asked about the ability of these treatments to effectively treat seeds in order to remove pathogens and biological agents for bio-security reasons and it was said that not a lot of research had been done in this field.” (In regards to cool plasma treatment).

-Page 5

5: Excerpt from Minutes: "A question was asked about the storage life after their treatment with microwaves. This was said to be increased but that long term effects on storage were not known."

-Page 5

6: Excerpt from Minutes: "A question about insect disinfestation was asked in regards to how long before further research was done into this. The period was said to be two to three years before this research was undertaken."

-Page 5

7: Excerpt from Minutes: "A question was asked about nanotechnology and the potential for its use to minimise dangerous microbial contamination. It was said that there were many treatments available for this, but that these may affect the produce."

-Page 5

8: Excerpt from Minutes: "A questions was asked of Dr Hellens in regards to the manipulation of a cow's diet to increase the milk production and if there were parallels that could be drawn upon in terms of vegetables. It was said that selection of germplasms could allow for advances similar to this with vegetables."

-Page 5

9: Excerpt from Minutes: "A question was asked to the panellists in regards to global population increase. It was asked if the technologies outlined could allow for food to be produced in a cheaper way. It was said that with the level of land degradation that had already occurred, there still may be a challenge to feed all these people even with these technologies. It was said that reduction in waste in the supply chain may help to address this."

-Page 5

10: Excerpt from Minutes: "A question was asked about the use of osmotic filters and these were said to be in research at the moment. It was said that this technology could use dirty and highly saline water to grow produce."

-Page 7

11: Excerpt from Minutes: "A question was asked about remote controlled tractors and the OH&S requirements. It was said that this was a good point and a challenge for the industry and that there was not an answer for this issue just yet. It was said that currently the cost of autonomous tractors is far too large and that work was being done to reduce these costs."

-Page 7

12: Excerpt from Minutes: “The use of a ‘creeping tractor’ and how this could be done legally was raised and it was said that the USDA regulations could not yet be met by John Deere due to the size of the wheels.”

-Page 8

13: Excerpt from Minutes: “A question was asked if this research could be used to detect insect movement and it was said that it could, but that it would be expensive. It was also asked if this work could be used in pack-houses and it was said that this was possible.” (In regards to robotics research).

-Page 8

14: Excerpt from Minutes: “A question was raised about microwave weeding, costs were raised and the ideas of automation were said to cut these costs.”

-Page 9

15: Another question was asked about row cropping and the effects it may have on crop surface roots and it was said that research was currently being undertaken in regards to this.”

-Page 9

9. Recommendations

- **Provide a tangible link to the web resources already available to growers through the AUSVEG website.**

Many large scale growers either have their own agronomists on staff or have accounts with Rural Service suppliers, such as Landmark, Elders or E. E. Muir representatives visiting 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.

- **Provide insight into areas of interest as outlined by the growers in attendance for potential expenditure of research and development funds.**

One of the key purposes of the seminar was to provide information to the governing bodies on where the growers would like their levy funds to go towards. There were many technologies outlined during this seminar which growers would be interested in having further research carried out with the assistance of the levy governing bodies and the Vegetable IAC. These areas are all outlined in the 'grower comments' section of this document.

- **Maintain contact with the researchers who participated in the day.**

Although the event was enormously beneficial, it is essential that industry maintains contact with the key speakers to monitor the development of the technologies. This will ensure that the benefits of these technologies will be reaching the growers as soon as possible. It would also enable the growers to find out exactly when these products will be available.

- **Provide information to researchers on opportunities for funding under the Horticulture Australia system.**

Providing a detailed process of how to apply for R&D funding under the Horticulture Australia system would open to doors to experts who are currently unaware of the availability of funding for horticultural research. This would help establish a larger base of researchers applying their developed technologies to agriculture, which, in turn, would result in more technologies beneficial to the growers. It would also provide additional competition for funding, and place additional emphasis on existing R&D projects to prove their value to the industry.

- **Provide annual future technologies seminars for relevant members of the vegetable advisory committees, influential growers, researchers and Horticulture Australia representatives.**

Hosting these seminars on an annual basis would enable industry to maintain an appreciation and interest in developing technologies. Currently, the relationship between researchers and industry is underdeveloped. Consequently, there is a less than satisfactory turnover of developed technologies that reach farmers or innovations which can be implemented successfully on farms. The Future Technologies Seminar has proven to be an effective way for industry to develop relationships with the research community so that grower concerns are taken into account in new technology development. An annual seminar would also enable researchers to have more interaction with growers which will guide research directions.

10. Conclusion

The seminar was the first step toward developing a relationship between future technology developments and the growers that these innovations are being designed to assist. Future investment decisions and R&D projects within the Australian Horticulture industry should use the perspectives contained within this report as a reference when assessing new research projects.

Given its ability to promote collaboration between researchers and growers, AUSVEG would is well-positioned to organise further Future Technology Seminars. A continued focus on future technologies will help to address the issues set to face Australian vegetable growers over the next 10 to 20 years, such as rising input costs, high labour costs, competition from cheap foreign imports, increasing taxes and regulations, and the requirement to be climate friendly and sustainable.

The 2012 Future Technologies Seminar has been an enormous success. The event received praise from all in attendance as is evident through analysis of the feedback provided. Most importantly, the event will be an important part of the vegetable industry calendar given the ongoing and emerging challenges facing the industry.

11. Appendices

APPENDIX 1 – Briefing Document and Agenda

APPENDIX 2 – Seminar Minutes

APPENDIX 3 – Media Coverage

APPENDIX 4 – Speaker Presentations

APPENDIX 5 – Speaker Reviews

APPENDIX 1
Briefing Document and Agenda

Future Technologies Seminar: Briefing and Outline

Wednesday 9 May – Wrest Point Hotel Casino, Hobart

The 2012 Future Technologies Seminar has been designed to assist members of the Australian vegetable production industry in the development of knowledge related to future technologies relevant to the many aspects of vegetable production. This seminar will outline various differing potential technologies and the ways in which they will benefit Australian vegetable growers, by bringing together industry specialists from research and commercial fields along with forward-thinking growers from throughout Australia.

The focus of the seminar is future technologies, recognising the need for increased crop yields and smarter crop management in order to address the rapidly increasing human population and food shortages worldwide. The technologies raised in the seminar will primarily be concerned with levied crops, but will not neglect other crops grown in most systems.

The range of topics to be outlined will cover the different sections of the vegetable production line, starting with seed and soil technologies through to the process and packaging of the farmed crops.

The seminar will be broken up into six topics:

1) **Genetic Modification**
2) **Agricultural Nanotechnology**
3) **Crop Processing Innovations**
4) **Irrigation Technologies**
5) **Harvesting Technologies**
6) **Agricultural Robotics**

Each topic will be presented by an expert in these respective fields. Every presentation will only occupy two thirds of its allocated time in order to allow for questions and general discussion amongst the people in attendance. To break up the first three topics, which are traditionally more controversial than the second, a panel discussion has been included in the seminar in order to discuss the potential issues that may present themselves with the development of these technologies.

As mentioned the objective of this seminar is to identify the potential for these technologies to assist growers in developing their farms to accommodate the growing production requirements of the Australian vegetable industry over the next ten to twenty years.

Over this period of time we can expect labour costs to continue to increase and the availability of labour to decrease, the amount of yields to increase and the cost of overall production from start to finish set

This project was facilitated by HAL in partnership with AUSVEG and was funded by the National Vegetable Levy
The Australian Government provides matched funds for all HAL's R&D activities.

HAL
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to increase. All of the topics listed for presentation will address these issues and present means for growers to make the required changes to their own methods of production in order to maintain a profitable and economically viable business.

The distinctive gap between specific problems found by growers, as opposed to the issues identified by scientists and research providers need to be bridged, in order to create a cooperative system that may act as a catalyst to addressing these issues and developing the industry. It is for this reason that a panel discussion and heavy grower involvement in all aspects of the seminar has been outlined as a key priority for the day.

Between now and the seminar on Wednesday 9 May, if you could please apply your mind to the potential innovative technologies that are in use on your farm, as well as identifying the specific areas that you think need attention, it would be beneficial to the seminar and participating members as a whole.

This project was facilitated by HAL in partnership with AUSVEG and was funded by the National Vegetable Levy
The Australian Government provides matched funds for all HAL's R&D activities.

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2012 Future Technologies Seminar: Program Outline

Venue: Derwent Room, Wrest Point Hotel-Casino, Hobart

Time: Wednesday 9 May 2012, 10:15am – 4:45pm

10:15am – 10:30am:

Guests arrive and morning tea and coffee is served

10:30am – 10:40am:

Welcome and Introduction by the Seminar Chair Dr Kevin Clayton-Greene.

10:40am – 11:00am:

Future Challenges for the Vegetable Industry

Speaker: Mr Jeff McSpedden (Vegetable IAC)

Topic Question: What are the challenges and issues vegetable growers in Australia going to be faced with in the next ten to twenty years?

11:00am – 11:45am:

Genetic Modification

Speaker: Dr Roger Hellens (New Zealand Plant & Food Research)

Topic Question: How can the development of genetic modification technology help to address some of the challenges set to face vegetable growers in Australia over the next ten to twenty years?

11:45am – 12:30pm:

Nanotechnology

Speaker: Dr Terry Turney (Monash University)

Topic Question: How can the development of nanotechnology help to address some of the challenges set to face vegetables growers in Australia over the next ten to twenty years?

12:30pm – 1:15pm:

Processing Innovations

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Speaker: Dr Mala Gamage (CSIRO)

Topic Question: How can the development of processing innovations such as plasma screening help to address some of the challenges set to face vegetable growers in Australia over the next ten to twenty years?

1:15pm – 1:30pm:

Panel Discussion

Panellists: Dr Roger Hellens
Dr Terry Turney
Dr Mala Gamage
Dr Graham Brodie
Mr Sam Birrell
Mr Kevin Platz
Prof Salah Sukkarieh

Panel Discussion: What are the potential issues farmers and consumers may have with the development and institution of these first three traditionally controversial technologies?

1:30pm – 2:15pm:

Seminar intermission to allow for lunch and individual discussion

2:15pm – 2:45pm:

Microwave Technology

Speaker: Dr Graham Brodie (University of Melbourne)

Topic Question: How can the development of microwave technology in relation to the removal and prevention of weeds help to address some of the challenges set to face vegetable growers in Australia over the next ten to twenty years?

2:45pm – 3:15pm:

Irrigation Innovations

Speaker: Sam Birrell (Agronomist - Netafim)

Topic Question: How can the development of irrigation technologies and techniques help to address some of the challenges set to face vegetable growers in Australia over the next ten to twenty years?

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3:15pm – 3:30pm:

Short break for afternoon tea and coffee

3:30pm – 4:00pm:

Crop Harvesting Innovations

Speaker: Mr Kevin Platz (Product Development Manager – John Deere)

Topic Question: How can the development of crop harvesting technologies and techniques help to address some of the challenges set to face vegetable growers in Australia over the next ten to twenty years?

4:00pm – 4:30pm:

Robotics in Agriculture

Speaker: Associate Professor Salah Sukkarieh (University of Sydney)

Topic Question: How can the development and institution of agricultural robotics help to address some of the challenges set to face vegetable growers in Australia over the next ten to twenty years?

4:30pm – 4:45pm:

Final Discussion and Conclusion

This time will allow for any final questions and comments to be made and discussed and a conclusion to be made by the Seminar Chair Dr Kevin Clayton-Greene.

4:45pm – 6:00pm:

After the conclusion of the seminar complimentary drinks will be provided at the adjoining bar within the Wrest Point Hotel Casino.

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APPENDIX 2
Seminar Minutes

2012 Future Technologies Seminar

Venue: Derwent Room, Wrest Point Hotel-Casino, Hobart
Time: Wednesday 9 May 2012, 10:15am – 4:45pm

The meeting commenced at 10.15am

Richard Mulcahy welcomed the attendees and noted that there had been a high level of demand from the Australian vegetable industry for a seminar on future technologies. Richard Mulcahy then handed over to Dr Kevin Clayton Greene, the Chair of the seminar.

Dr Clayton Greene discussed a number of technologies which are now out-dated. The Chair outlined how agricultural technologies had evolved in the past 20 years and stated that many of the technologies that are used today did not exist back then.

The Chair discussed how global technology was set to increase dramatically in the near future. He then introduced Mr Jeff McSpedden, Chair of the IAC and remarked that he is very well known and respected in the vegetable industry.

Mr McSpedden said that in the 1950's vegetable farms were far more profitable. He mentioned that there was still a challenge and a need for good, high quality food. He said that when things get tough in other countries, overseas nations would turn to Australia.

Mechanisation to overcome labour is one of the largest challenges that the industry is facing. It was said that quick drying resins could be used to quickly and efficiently produce robotic technology. He also mentioned graphing, where a number of elements are used to produce graphite. It was said that this technology was already at use in airports and also to detect Improvised Explosive Device's in Afghanistan.

The Chair also discussed micron technology and how it could be used in horticulture. He discussed vision sensors and the problems related to these. The Chair then bought up the topic of GM and discussed that there was not a large amount of support for the technology. Canola crops were discussed in regards to Omega three and how they had been modified to produce much larger amounts of this nutrient. It was also said that the partner companies had produced a chemical which could specifically target genetically modified crops if they became a pest.

The Chair outlined that the real competitor to vegetables is actually the other commodity groups in the supermarket. It was said that increasing this demand was important and that the SIP had identified this as an important direction for the industry.

The Chair outlined that preparation books focussing on how to maintain nutrients would potentially be beneficial to the industry.

A question was asked in regards to the removal of broad spectrum chemicals currently in use by the Australian vegetable industry. It was said that maintaining a chemical which can destroy GM plants which become a weed will be necessary. It was said that if the changes brought about by GM were minor and beneficial, it should be supported.

A question was asked about water access in Australia. It was said that this was a large problem in

NSW and that Coal Seam Gas mining would affect this in a negative fashion. It was said that some of the technologies were being developed overseas.

Dr Roger Hellens – Genetic Modification (New Zealand Plant & Food Research)

The Chair introduced Dr Roger Hellens to speak on the topic of GM. Dr Hellens thanked AUSVEG for inviting him to speak at the event today. He said that most of the work that he had done had been in regards to fruit, but that the technology remained the same for vegetables.

It was said that selective breeding had been occurring for a long period of time. It was said that the core component of genomic research was the crops that were being worked on and that consumer needs were very important. It was also said that being aware of the desirable traits was very important.

It was said that sequencing DNA had become much easier and cheaper, however it produces a huge amount of data and that combining these DNA sequences in order to create an organism was a challenge.

The screening and sequencing processes were outlined and it was said that these processes could now be completed very quickly. Dr Hellens said that germplasm knowledge allowed for cross breeding between very different types of the same species. The example of NZ Sauvignon Blanc was given and it was said that all of these plants had been bred from a very small number of twigs.

It was said that dwarfing rootstocks could increase water efficiencies in horticulture. The red-fleshed apple was given as an example, which spontaneously appeared in Kazakhstan a number of years ago.

It was said that a breeding program had been used to produce red fleshed apples using this original genome information from Kazakhstan. These apples were said to have an increased level of browning, but that being aware of this would allow the industry to develop a different processing approach to reduce the occurrence of this.

Emerging techniques in GM were said to be more subtle and use many of a plant's inbuilt abilities.

This was said to be quite different from the existing perception of GM.

Dr Hellens also talked about next generation mapping techniques and how it could be used to ensure seedlings had all received the same genetic instructions through their DNA. The sequencing of the genome made this possible.

Dr Hellens discussed minor allele variation within plants and said this was due to the different layers of a plant. He mentioned that this variation could allow for greater genetic diversity and potentially help to develop disease resistant strains.

In summary, Dr Hellens said that genomic sequencing could now be used for real plants instead of reference plants.

A question was asked regarding consumer satisfaction in regards to sight, texture and flavour in regards to purchase behaviour. It was said that colour is a good initial sensory consumer attractant, but in regards to repeat purchase, taste and flavour were said to be vitally important.

A question was asked about consumer acceptance of GM and the response given was that consumers had always been wary of technology that could not be understood and that they had accepted these regardless.

A question was asked about which of the technologies shown in the presentation were closest to commercial usage. The answer was given that PSA resistance in Kiwifruit was something which will be used in the very near future. It was said that a lot of these technologies were being used right now.

A question was asked about plant genetics and working with medicine. It was said that there was a link between fruit and health. There were said to be nutrients in apples which were now used to assist diabetics. In addition to needing to feed more people, it was said to be important to feed them produce which is better for their health.

The Chair asked how many people were aware of the GM work that had been done in potato crops, and only two people indicated that they were aware of this research.

Dr Terry Turney – Agricultural Nanotechnology (Monash University)

The Chair introduced Dr Terry Turney and gave a brief outline of his background. Dr Turney said that genetics was a very exciting topic and that topics which were previously science fiction were now commercially available.

Nanotechnology was said to have been put in use by nature for 3 million years. It was said that community perception was one of the major obstacles to these technologies.

Nanotechnology was explained as the creation of devices, systems and materials on an incredibly small scale. Dr Turney began with an explanation of exactly how small this technology really is. It was said that on a Nano scale, surface effects are much more important and can be exploited.

It was said that nanotechnology in agriculture was still in a very early stage.

Dr Turney said that he would discuss four applications of nanotechnology including sensor technology, and that nanotechnology would allow for sensors to become much more affordable and disposable in nature.

Nanotechnology can allow printers to print things such as a flexible battery and that these will possibly be available within the next ten years. It was said that antennas and transmitters were able to be printed on paper right now. Dr Turney mentioned that market access was a major challenge to this and that a market for these things currently did not exist. The challenge was said to be in the establishment of the supply chain. Another challenge was said to be interference of radio frequency.

It was explained that packaging was an area where nanotechnology had been used for a while and that packaging could be embedded with intelligent technology and that this could examine the suitability of this produce to eat. Active packaging was discussed and it was noted that this technology could be used to allow vegetable produce to create its own atmosphere. Breathable film technology was highlighted as a way of controlling ripening processes and fungal attack. This technology was said to allow control of the ripening hormone ethylene and reduce it to a level where produce life could be greatly improved.

Controlled release and scrubbing were discussed by Dr Turney and this technology was said to be employable to release or trap bioactive materials. Nano sized particles could be used to clean contaminated water or remove imbalances in phosphates. Enhanced plant growth was said to be another field where nanotechnology could potentially be used within agriculture. Dr Turney said that the safety of this technology was not yet known, but that it was fascinating and allowed plants to grow faster using less water.

Food scarcity was said to be a major global issue in the next 10 years and that it was even an issue on a nutrient level. It was said that soils could be fortified with micronutrients and that these could be taken up by the plant. These plants had the potential to be marketed in a different way in order to be more beneficial for consumers.

A question was asked about "snake oil" products and the response was that there needed to be scientific, evidence based proof for these products. The question was reframed to discuss the health aspects of this. It was said that there was very little evidence about the negative aspects on health, but that these had not fully been examined scientifically and that these should remain in the laboratory until they are proven to be safe.

Dr Mala Gamage – Crop Processing Innovations (CSIRO)

The Chair introduced Dr Mala Gamage and gave a brief outline of her background. Dr Gamage discussed different innovative technologies and how they could be used along the value chain.

Dr Gamage introduced the topic of cool plasma – which was said to be like water treated with a high level of energy. Cool plasma was outlined as a gas at 30-60 degrees and charged with ions. This can be used to treat seeds for surfaces. This technology is used in medicine to treat wounds and could be used to disinfect seeds. Cool plasma can also be used to treat for microbial inactivation and was said to leave no chemical residue and involve minimal surface alteration.

Low energy electron beams were said to be similar to those in CRT televisions. It was said that this technology was widely used in Europe, where it is used on nuts. In Australia there was said to be no technical differentiation between electron beam and irradiation technology.

Microwave treatments were outlined and it was said that a microwave unit could heat a product perfectly evenly. The temperature differential seen with traditional microwaves was said to be eliminated due to the number of sources and programming of their activation.

High pressure processing was said to be useable on products including chopped materials, allowing the texture and surface to remain unchanged. High pressure could also be used to restructure fruit and vegetable products.

Ultrasonic processing was discussed and it was said to cause bubbles in water to release large amounts of energy and pressure. It was also described as a method to pre-treat a number of plant fibres, including potatoes, reducing the amount of oil taken up in frying and also improving the crisping of these products.

It was said that these technologies could be used to take beneficial compounds out of waste streams and reuse them, thus improving efficiencies.

A summary of these technologies was given including the stage of development that a number of these technologies were in, many of which are already commercially available.

A question was asked about the relationship between nanotechnology and food processing. It was said that there was a potential relationship, but that care had to be taken in order to minimise the detrimental effects of these treatments.

A question was asked about the ability of these treatments to effectively treat seeds in order to remove pathogens and biological agents for bio-security reasons and it was said that not a lot of research had been done in this field.

A question was asked about the storage life of products after their treatment with microwaves. This was said to be increased but that long term effects on storage were not known.

A question about insect disinfestation was asked in regards to how long before further research was done into this. The period was said to be two to three years before this research was undertaken.

Panel Discussion

Panellists:

- Dr Roger Hellens
- Dr Terry Turney
- Dr Mala Gamage
- Mr Jeff McSpedden

The Chair introduced the panel and asked the first question about adoption by society.

It was said that this was very important and that education was vital in regards to this. Roger Hellens stated that with some research he was involved in based in California, people were willing to eat GM apples as long as they were approved by the US Food Safety Board. Dr Gamage said that microwave technology and treatment would be easier to educate consumers about as many consumers have a microwave. Laser eye treatment was offered as another example and that people were not given a choice to use it or not if it was recommended by their doctor.

A question was asked about nanotechnology in regards to reduction of evaporation and it was said that it had been discussed a lot within the field. It was said that it was very hard to control due to wind and wave action and the effect that this had. However it was said that soil could actually be modified to store more water.

A question was asked about nanotechnology and the potential for its use to minimise dangerous microbial contamination. It was said that there were many treatments available for this, but that these may affect the produce. A question was asked in regards to people’s perceptions of foods treated in certain ways. It was said that a large amount of market research had been done in regards to this.

A question was asked of Dr Hellens in regards to the manipulation of a cow's diet to increase the milk production and if there were parallels that could be drawn upon in terms of vegetables. It was said that selection of germplasms could allow for advances similar to this with vegetables.

A question was asked of the panellists in regards to global population increase. It was asked if this technology could allow for food to be produced in a cheaper way. It was said that with the level of land degradation that had already occurred, there still may be a challenge to feed all these people even with these technologies. It was said that reduction in waste in the supply chain may help to address this.

The meeting stopped for lunch at 1.30pm and recommenced at 2.15pm

Dr Graham Brodie – Microwave Technology (University of Melbourne)

The Chair introduced Dr Graham Brodie and gave a brief outline of his background.

Dr Brodie began by outlining how microwaves work and explained that they are part of the light spectrum. He continued, outlining the available industrial frequencies in Australia. Dr Brodie outlined how standing waves fluctuated up and down and highlighted on the size of the item being exposed. He explained that size was important in terms of efficiency.

A question was asked regarding what industrial microwaves do to railway sleepers and it was said that the microwave treatment was a pre-treatment.

Microwaves were said to be penetrating and this was different to normal surface heating technology.

Dr Brodie gave the example of a microwave treatment of weeds, and showed a video of the treatment killing a weed. He continued, outlining the horn antenna as a way of projecting microwave energy. He described how the microwave continued through the soil to damage roots. Dr Brodie showed how microwave treatment caused plant stems to heat up from the inside. He continued, showing how a plant which had been treated by microwave as a result could not remain alive.

Dr Brodie played a video from Mythbusters which outlined exploding water as a result of microwave treatments, then drew analogies between this and the microwave treatment of plants, highlighting how this treatment would destroy these plants.

Dr Brodie outlined how different soil types received microwave treatment in different ways, depending on how much moisture they contain. It was said that seed moisture content affected how effective microwave treatments were on the seeds. Microwave treatment was also shown to affect the levels of bacteria in soil, with greater treatment levels decreasing bacteria levels.

An example of a microwave machine from the 1970's was shown and it was said to be ineffective.

Dr Brodie also outlined how microwave technology could be used to damage weed seeds in hay.

A question was asked about the dose response in relation to rye grass seeds and it was said that high levels of dosage were more effective.

Sam Birrell – Irrigation Innovations (Agronomist - Netafim)

The Chair introduced Sam Birrell and gave a brief outline of his background.

Sam gave an outline of the development of drip feed irrigation and gave a background of Simcah Blass from Israel, who developed drip irrigation. Mr Birrell also gave a brief history of previous drip irrigation technology, and then gave an outline of how drip irrigation works through the creation of turbulence. He then listed some major issues facing farmers including: labour, energy, water and nutrients and market acceptance.

The cost of labour was said to be a major issue for farmers and he gave an outline of how quick recoil irrigation technology could dramatically increase efficiency and reduce labour costs. Water was outlined as being another important resource and he then outlined efficiency of water usage as dependent on the amount of water taken in by a plant.

Low flow dripper technology was said to be important as it allowed for water be applied to crops in a very slow way, which improves the health and yield of a number of plants. A flow on benefit of this was that it would allow energy to be used in a more efficient way as well.

Nutrigration was said to be a developing technology which was based in the greenhouse growing industry. Mr Birrell also showed some technology which can monitor and control the pH and delivery of salts in irrigated solutions.

Mr Birrell's presentation finished at 3.07pm

A question was asked about the use of osmotic filters and these were said to be in research at the moment. It was said that this technology could use dirty and highly saline water to grow produce.

Mr Birrell said that in the future, these technologies have the potential to be used to irrigate fields in Israel with waste water from Tel Aviv.

A question was asked about the durability of irrigation technology and the response was given that the wall thickness affected how long the tubes could last for.

Kevin Platz – Harvesting Technologies (Product Development Manager – John Deere)

The Chair introduced Kevin Platz and gave a brief outline of his background.

Mr Platz gave an outline of John Deere's role within the horticultural industry. It was said that a number of innovations are driven by the consumer, who is the farmer or grower in the marketplace. It was said that specialty crops such as vegetables have higher production costs as well as issues with market timing, quality and quantity. Labour management and also the management of resources were also seen as being pivotal issues in the vegetable industry.

It was said that there are over 60 types of vegetable harvesting machines and that it was a challenge to choose which areas to focus upon.

It was said that customers frequently did not understand the technology that was often contained within their tractors.

One of the major things that John Deere are said to be working on is that of perception sensing and showed a diagram which included all the different sensory technologies including lasers, stereo cameras and image processing technologies.

Robotics was also touched on as something that John Deere is currently working on, in regards to an autonomous tractor, and that these were starting to be seen in the marketplace, however, there were a number of different safety guidelines that had to be adhered to internationally.

A question was asked about remote-controlled tractors and the OH&S requirements. It was said that this was a good point and a challenge for the industry and that there was not an answer for this issue just yet. It was said that currently the cost of autonomous tractors is far too large and that work was being done to reduce these costs.

The use of a 'creeping tractor' and how this could be done legally was raised and it was said that the

USDA regulations could not yet be met by John Deere due to the size of the wheels. It was said that the laws in California had been adopted almost globally as a standard.

A question about the remote control for mowing lawns was raised and if it could be added to a tractor. It was said that this could not be done at the moment due to the circle of safety around the vehicle.

Dr Salah Sukkarieh – Agricultural Robotics (University of Sydney)

The Chair introduced Dr Salah Sukkarieh and gave a brief outline of his background.

Dr Salah described and gave a brief history of his research department. He demonstrated that the robotics department had worked closely with industry.

Dr Sukkarieh outlined work that had been completed in regards to unmanned aircraft. Dr Sukkarieh demonstrated how a number of robots had been developed to train snipers and that the sensors and sharing capabilities of these robots are highly complex.

Salah also showed images of weed detection flying technologies which were said to be very useful.

Another example was given of automated wharf vehicles and that the benefits of these were multifaceted including better fuel efficiency, tyre usage and general effectiveness.

Another project was shown using automation of mining technology. The large cost problem with mines was said to be that of labour, so autonomous trucks and machinery had helped to cut these costs.

It was said that ideally this technology would be used as a platform for software development which could increase how useful this technology could be.

It was said that the key areas for this work were: sensors, rich representations, probabilistic models and data fusion and mapping. It noted that it was important that a robot could identify objects in the field. One such example was a robot that could identify a weed as opposed to a desired plant in a crop. There were said to be a large number of people experimenting in this field and that automation is not the only benefit, there are a number of additional benefits which can be seen as a flow on from this advance.

The horticultural robotics research that Dr Sukkarieh's team has conducted has only been undertaken in the past 5-7 years. It was said that a long term relationship was required in order to see benefits from robotics and that many of their partners had been involved for up to 15 years.

A question was asked if this research could be used to detect insect movement and it was said that it could, but that it would be expensive.

A question was asked if this work could be used in pack-houses and it was said that this was possible.

The idea of an agronomist working across a number of farms from a centralised office was raised and it was said that this was possible but that current camera technologies may make this unfeasible due to light effects.

A comment was made that the Chair and Salah would be a perfect match in order to work together to solve a number of the problems that the industry is facing and that there was a huge opportunity to make this work.

The issue of OH&S was raised and said to be a big issue for the industry. It was said that a large amount of collaboration would be needed in order for these technologies to be deemed safe by government bodies. It was asked if the AUSVEG Directors present in the room could take up these issues with the government. Safeguards such as safe areas were seen as a way around this situation.

A question was raised about the development of gantry tractors, and it was said that this technology has been looked at in the past 3-4 years.

A question was raised about microwave weeding, costs were raised and the ideas of automation were said to cut these costs.

Another question that was raised was in regards to the type of stored energy capabilities available at the moment. It was said that this research had only been done on a small scale but that in comparison to herbicides, that the cost is much lower and that this depends on if the grower is treating weeds or the actual soil. It was said that herbicides led to plant species which are resistant to chemicals.

Another question was asked about row cropping and the effects it may have on crop surface roots and it was said that research was currently being undertaken in regards to this.

It was said that one of the major things that had come out of the day was the broad range of fields that had been covered.

The Chair thanked the panel and AUSVEG.

The meeting concluded at 4.45pm

APPENDIX 3
Media Coverage

Media Release

3 May 2012 **For immediate release**

Future technologies seminar to assist growers in feeding future generations

A seminar outlining future technologies including advanced robotics and microwave weed control measures will take be held on Wednesday 9 May for Australian vegetable and potato growers at Wrest Point Hotel Casino in Hobart, Tasmania.

With the global population predicted to reach 9 billion by 2050, food producers are increasingly turning to advanced technology to improve their efficiency and output.

“This seminar will educate Australian growers about some of the advanced technologies being developed which may assist them with remaining efficient, productive and economically viable in the future,” said AUSVEG spokesperson Hugh Gurney.

AUSVEG is the National Peak Industry Body for Australia’s 9,000 vegetable and potato growers.

Presenters at the seminar will include Associate Professor Salah Sukkarieh from the University of Sydney robotics department, nanotechnology expert Dr Terry Turney from Melbourne’s Monash University, international genetic modification expert Dr Roger Hellens from New Zealand Plant & Food Research and microwave technology exert Dr Graham Brodie from the University of Melbourne.

Also to present at the seminar is CSIRO’s Dr Mala Gamage and representatives from the international award winning research and development departments of John Deere and Netafim, the world’s leading drip Irrigation Company.

“This seminar, which will be held at the Wrest Point Hotel Casino in Hobart, from 10:30am – 4:45pm, will outline what these technological developments are and how they can be used to address these issues set to face our vegetable growers,” said Mr Gurney.

“Leading scientists and industry specialists will be able to discuss the possible advantages and disadvantages of these technologies on equal terms in this open forum style seminar, resulting in a better understanding for the attendees on both sides of the spectrum.”

“We are hoping that this seminar will not only succeed in providing important information to the growers themselves, but to the researchers and industry specialists who will benefit from close interaction and discussion with the calibre of vegetable and potato growers in attendance,” said Mr Gurney.

This project has been funded by Horticulture Australia Limited using the National Vegetable Levy and matched funds from the Australian Government.

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Budget no fast-fix for highway

Plan ahead to avoid elder abuse

Sunday Canberra Times, Canberra
06 May 2012, by Michael Inman

General News, page 8 - 282.38 cm²
Capital City Daily - circulation 30,262 (------S)

ID 144805423 BRIEF AUSVEG INDEX 1

A taste of the future on offer in Hobart

By MICHAEL INMAN

A MICROWAVE with a hole in the side may look like a backyard experiment about to go horribly wrong.

But this Frankenstein prototype could soon play a crucial role in building global food security.

With the global population predicted to reach nine billion by 2050, food producers are busy hunting technology to improve efficiency and yield.

And some of the machines on show at a future technologies seminar this week could provide a sneak peek into cropping practices of the future.

The seminar, to be held in Hobart on Wednesday, will feature presentations on robotics, nanotechnology, genetic modification and microwave technology.

The off-beat microwave invention, using a household kitchen oven, is being tested as a new form of selective weed control.

The technology is more environmentally friendly than chemicals and can focus on individual weeds without affecting neighbouring plants.

Other seemingly quirky concepts on show include a robot that uses sensors and algorithms for tree segmentation and fruit classification, and radiation treatment for fresh fruit and vegetables that kills fruit fly and extends shelf life.

The conference has been organised by Ausveg, the peak industry body for Australia's 9000 vegetable growers.

Ausveg spokesman Hugh Gurney said the seminar would show Australian growers how technological developments can benefit their business.

"The seminar will educate Australian growers about some of the advanced technologies being developed which may assist them with remaining efficient, productive and economically viable in the future," Mr Gurney said.

"We are hoping the seminar [will provide] important information to growers [and benefit] researchers and industry specialists . . . through close interaction and discussion with the calibre of vegetable and potato growers in attendance."

Microwave technology is being tested as a new form of selective weed control, main, and a shrimp device, inset

THU 10 MAY 2012, 10:03 AM

Media Alert

2 media items prepared for Ausveg. For queries regarding this Media Alert or other Media Intelligence services, contact service@mediamonitors.com.au.

Radio (2 items)

AusVeg is hosting a seminar on food growth today, and will g...

2MCE, Orange hosted by **Newsreader** — 09 May 2012 4:01 PM
16:00 News - 0 min 42 secs - ID: M00048611476

AusVeg is hosting a seminar on food growth today, and will give an opportunity for farmers and researchers to come together and discuss the future of the industry. The Hobart seminar will outline future vegetable growing technology.

Order presentation file or transcript

Interviewees
Hugh Gurney, Communications Officer, AusVeg

Also broadcast from the following 71 stations

N/A ALL
N/A MALE 16+
N/A FEMALE 16+

AUSVEG says Australia will play a growing role in food produ...

2MCE, Orange hosted by **Newsreader** — 09 May 2012 1:01 PM
13:00 News - 0 min 47 secs - ID: M00048609081

AUSVEG says Australia will play a growing role in food production and exportation in the coming years as a summit on food growth is held in Hobart today.

Order presentation file or transcript

Interviewees
Hugh Gurney, Communications Officer, AUSVEG

Also broadcast from the following 70 stations

N/A ALL
N/A MALE 16+
N/A FEMALE 16+

FRI 11 MAY 2012, 10:03 AM

Media Alert

4 media items prepared for Ausveg. For queries regarding this Media Alert or other Media Intelligence services, contact service@mediamonitors.com.au.

Radio (4 items)

AUSVEG has expressed confidence its $65 million research pla...

ABC 936 Hobart, Hobart hosted by **Newsreader**
07:45 News - 0 min 38 secs - ID: W00048637925

11 May 2012 7:54 AM

AUSVEG has expressed confidence its $65 million research plan will boost the confidence of Tas growers. The initiative has been funded via a levy to growers, which has been matched by the Federal Government.

Order presentation file or transcript

Keywords
AUSVEG (1)
Interviewees
Richard Mulcahy, AUSVEG

N/A ALL
N/A MALE 16+
N/A FEMALE 16+

The Tas Liberal Party has unveiled its plan to transform sta...

ABC Northern Tasmania, Launceston hosted by **Newsreader**
06:30 News - 0 min 50 secs - ID: W00048635504

11 May 2012 7:01 AM

The Tas Liberal Party has unveiled its plan to transform state agriculture into a $10 billion industry. Leader Will Hodgman has promoted the potential for growth.

Order presentation file or transcript

Interviewees
Richard Mulcahy, CEO, AUSVEG
Will Hodgman, Tasmanian Opposition Leader
Also broadcast from the following 1 station

N/A ALL
N/A MALE 16+
N/A FEMALE 16+

Onion growers from around the country met in Hobart yesterda...

ABC 936 Hobart, Hobart hosted by **Tony Briscoe** 10 May 2012 12:50 PM
Tasmanian Country Hour - 0 min 46 secs - ID: W00048627634

Onion growers from around the country met in Hobart yesterday as part of the **Ausveg conference**, tomorrows program will be broadcasting live from the **conference** tomorrow.

Order presentation file or transcript

Keywords

conference (2), Ausveg (1)

Also broadcast from the following 1 station

N/A ALL
N/A MALE 16+
N/A FEMALE 16+

AusVeg is hosting a seminar on food growth today, giving an ...

2MCE, Orange hosted by **Newsreader** 09 May 2012 7:01 PM
19:00 News - 0 min 42 secs - ID: W00048614462

AusVeg is hosting a seminar on food growth today, giving an opportunity for farmers and researchers to come together to discuss the future of the industry. The seminar in Hobart will outline the future technology for vegetable growers. Communications Officer Hugh Gurney says he expects the seminar to be beneficial and engaging.

Order presentation file or transcript

Interviewees

Hugh Gurney, Communications Officer, AusVeg

Also broadcast from the following 68 stations

N/A ALL
N/A MALE 16+
N/A FEMALE 16+

APPENDIX 4
Speaker Presentations

The New Zealand Institute for Plant & Food Research Limited

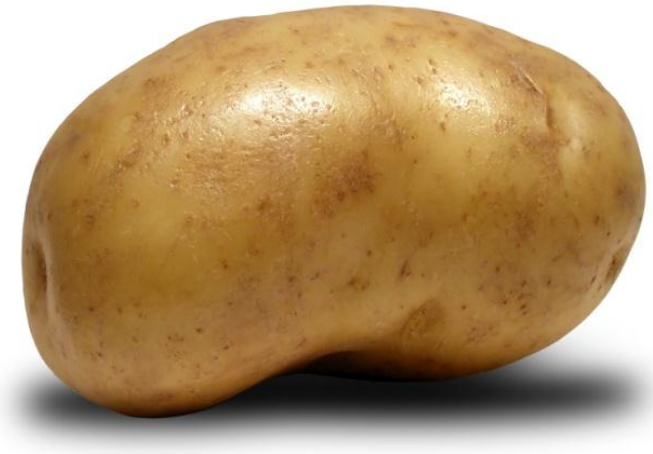
Plant & Food RESEARCH
RANGAHAU AHUMĀRA KAI

Emerging technologies in the horticultural industry

Roger Hellens, Science Group Leader, Genomics

AusVeg– May 2012

Real Plants - Crops



New Cultivars- Accelerated Domestication

Breeding and Genomics

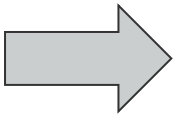
Traits

Crops

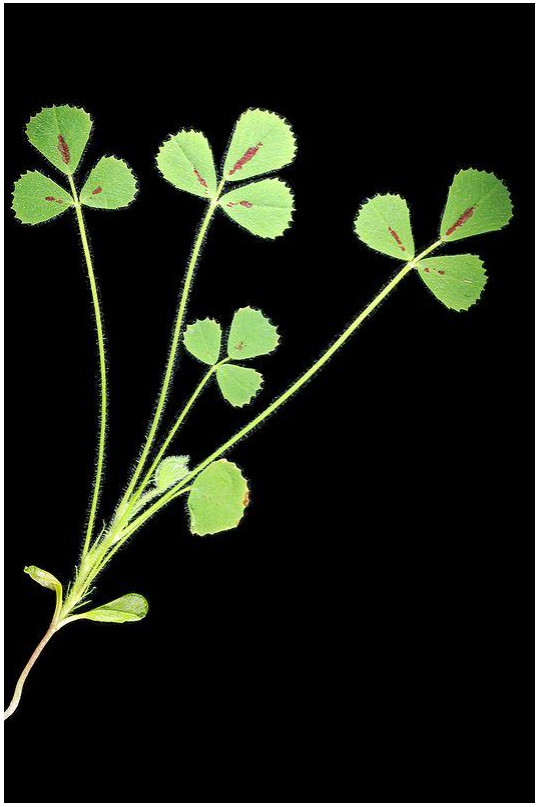
Technology

Next Generation sequencing

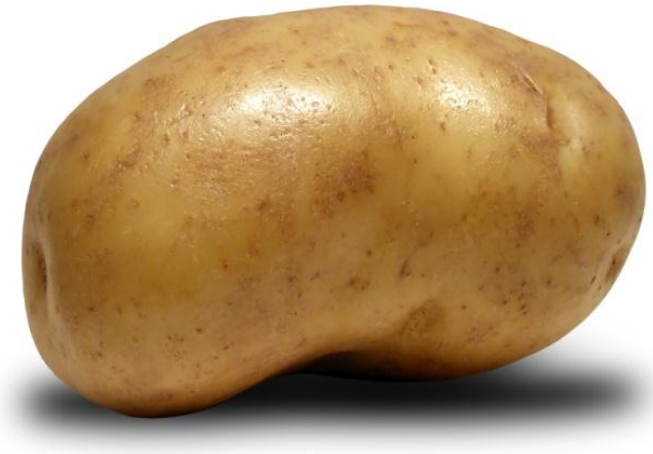
Genome assembly



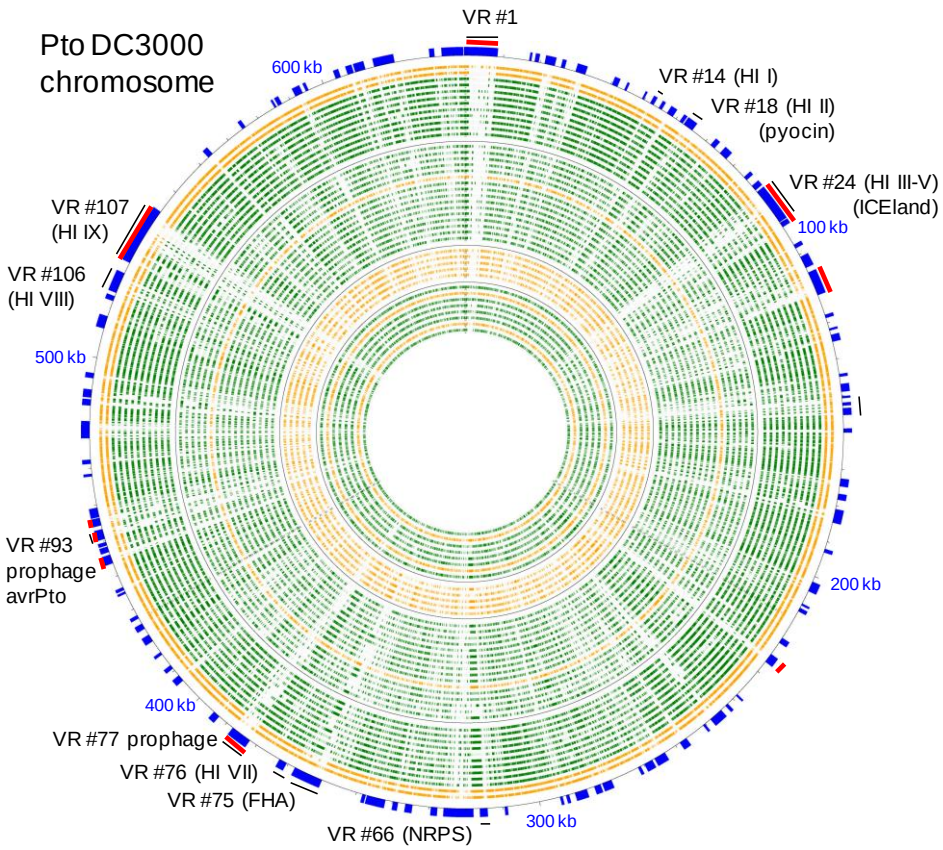
References Plants



Real Plants - Crops



Psa


Pto DC3000
chromosome
VR #1
600 kb
VR #14 (HI I)
VR #18 (HI II)
(pyocin)
VR #24 (HI III-V)
(ICEland)
100 kb
VR #107
(HI IX)
VR #106
(HI VIII)
500 kb
VR #93
prophage
avrPto
200 kb
400 kb
VR #77 prophage
VR #76 (HI VII)
VR #75 (FHA)
VR #66 (NRPS)
300 kb

Apple scab fungus

The Genome – 85% complete

- Illumina only
- Genome size – Small
- PFR – specific pathogen race

Potato

The Genome – 1st draft complete

- Illumina then 454 and Sanger
- Polyploidy
- International collaboration - BGI

Kiwifruit

The Genome

- 650 Mb
- Diploid
- F3 backcross (40% homozygous)

- BAC library of parent
- Genetic map of patent

Elena Hilario; Ross Crowhurst

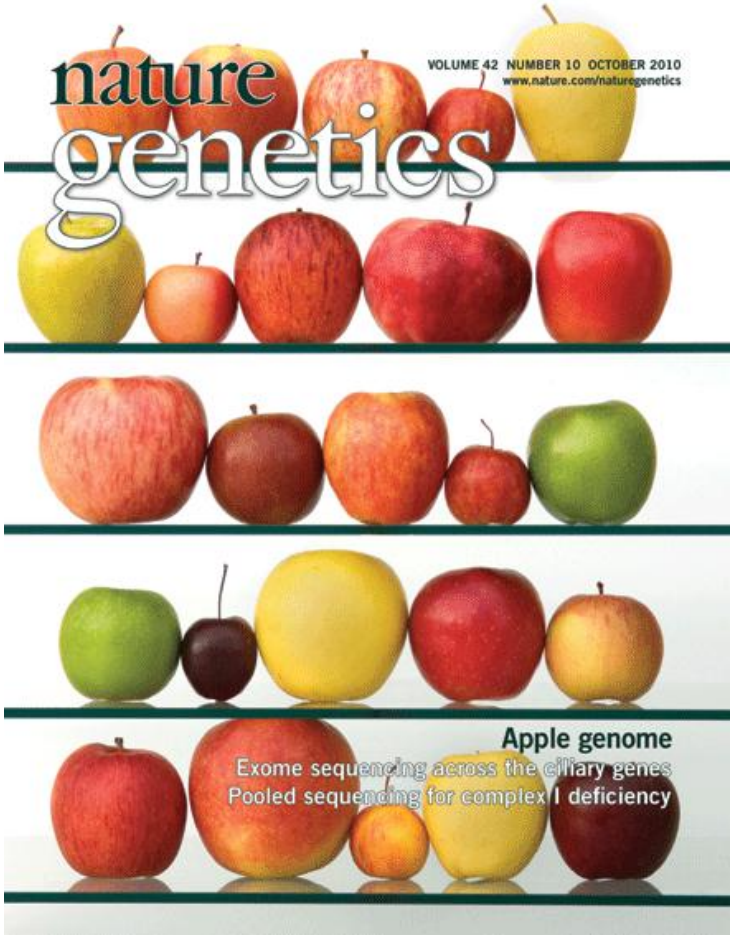
Apple Genome and resequencing

Apple Germplasm	comments
'Robusta 5'	resistance: fire blight, scab, mildew, woolly apple aphid (WAA), Euro canker, SARD
'Malling 9'	rootstock dwarfing genes; resistance: *Phytophthora*, SARD, Euro canker?
91.136 B6-77	'Big Red', progenitor of Type 1 red flesh; resistance to scab and WAA
92.118 F34-056	progenitor of Type 2 red flesh;
'Aotea'	resistance: scab, mildew, woolly aphid, fire blight,; yellow flesh
M. sieversii accession	progenitor domesticated apple
'Geneva'	*M. niedzwetzkyana*, Type 1 red flesh; resistances: scab, WAA
'Merton Russet'	progenitor tropical flavour
'Wilmont Russet'	progenitor nutty flavour
'David' o.p. A15-199	resistances; mildew, WAA; crossed with Royal Gala: progeny good fruit quality

Apple Cultivars	comments
'Braeburn'	Founder of cultivar breeding; parent of 'Jazz' and 'Envy'
'Granny Smith'	Founder of cultivar breeding;
'Cox's Orange Pippin'	Founder of cultivar breeding; widely used in USA for breeding
'Splendour'	Founder of cultivar breeding; parent Pacific series; biennial bearer
'Idared'	Founder of cultivar breeding; 'Jonathan' x 'Wagener'
'James Grieve'	Founder of cultivar breeding; regular bearer
'Red Dougherty'	Founder of cultivar breeding;
'Ralls Janet'	Founder of cultivar breeding; parent of 'Fuji'

Apple Breeding parents	comments
Pinkie	Vf, PI2 (A038R002T118)
A160R02T017	T17; A045R013T007 x A020R002T167)
A154R09T157	Vf, PI2 (A020R001T289 x A038R002T086)
A158R09T102	PI1 (A016R016T035 x A039R003T095, ex *M. robusta*)
A068R03T057	Vh2 (Sciher x OB1T2T41, ex Russian apple R12740-7A)

Pear	comments
'Williams BC'	aka 'Bartlett' European pear *P. communis*
'Old Home'	European pear *P. communis*; parent of dwarfing rootstock mapping population; fire blight resistance
'Louise Bon Jersey'	European pear *P. communis*; parent of dwarfing rootstock mapping population
'Nijisseiki'	Japanese pear *P. pyrifolia*
P092R011T125	Superior texture; Interspecifc with Chinese pear 'Huobali' x 'Shiyuehuali'; *P. bretschneideri*
P037R048T106	NJ10 x 29-52 (interspecific; exceptional texture)



Germplasm - alleles

Germplasm – somoclonal variants

Traits

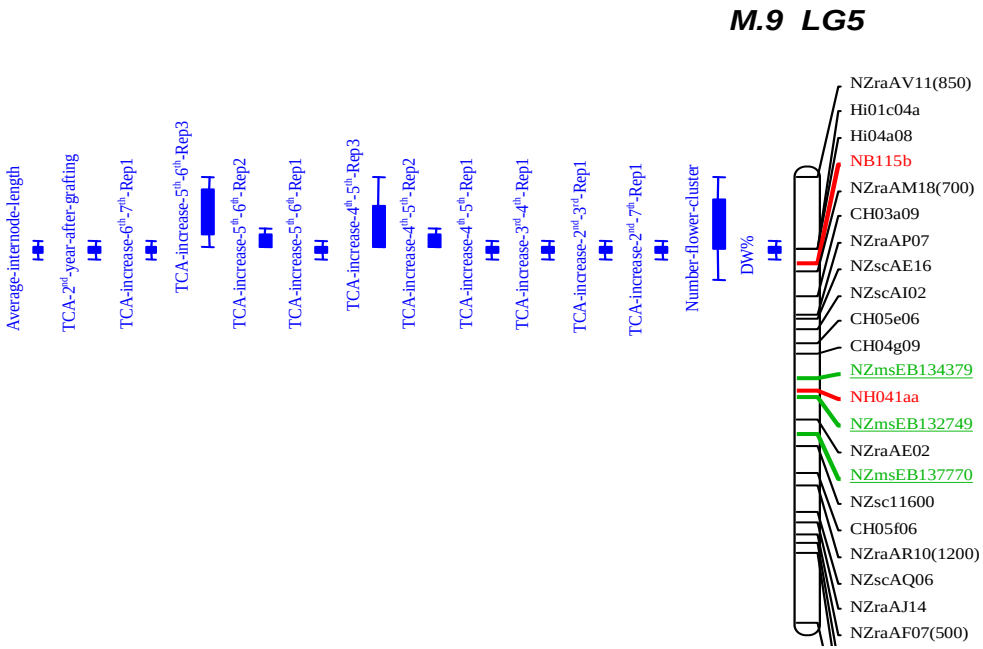
INPUT: Production

- *Disease resistance*
- *Flowering*
- *Dormancy*
- *Plant architecture*

OUTPUT: Consumer

- *Pigments and Health*
- *Flavours*
- *Carbohydrates*
- *Texture*

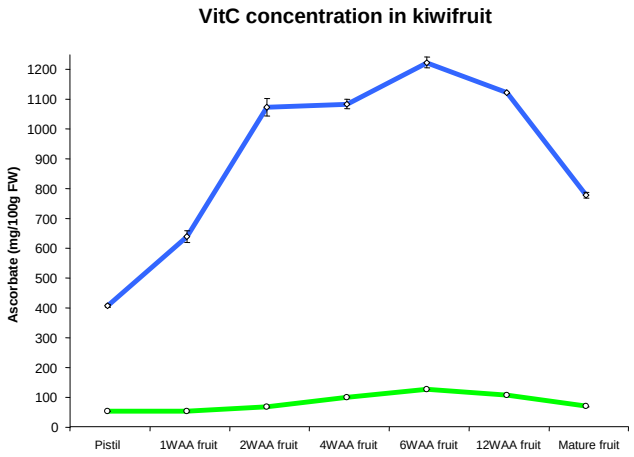
Dwarfing rootstocks – *DW1*



High Vitamin C – *VTC2*

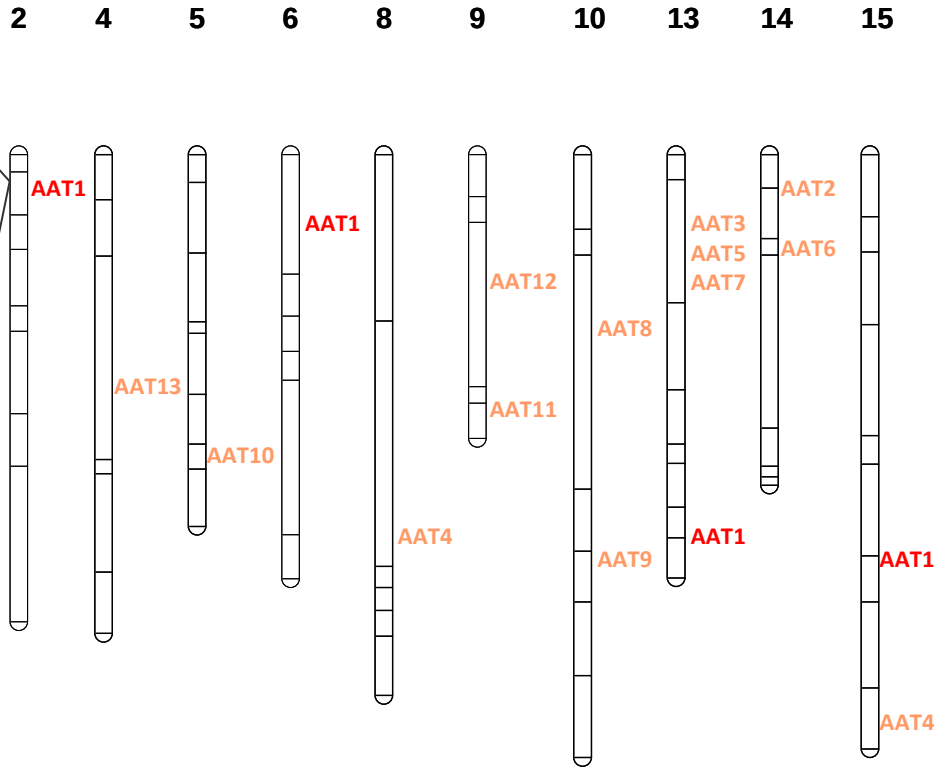
A. erianther

A. deliciosa



Laing *et al.,* PNAS (2004 and 2007)

Ripe Apple Flavour – *AAT1*



Edwige Souleyre; Daryl Rowan

Orange kiwifruit - *LCY-B*

GERANYL GERANYL PYROPHOSPHATE

↓

PHYTOENE

↓

ζ-CAROTENE

↓

LYCOPENE

↓

β-CAROTENE

↓

ZEAXANTHIN

↓

α-CAROTENE

↓

LUTEIN

Ampomah-Dwamena, et al JXB (2009) **60**:3765-79

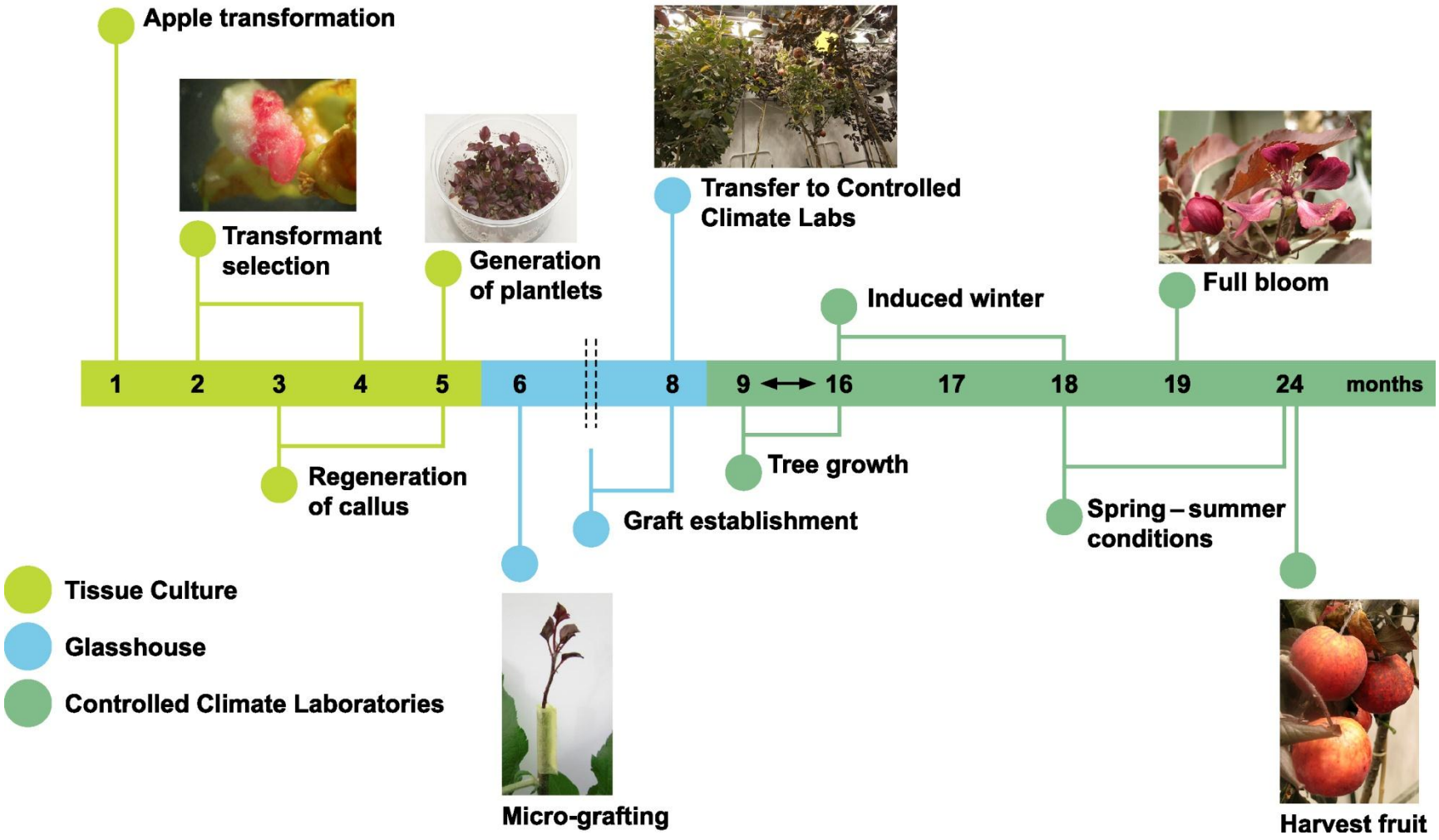
Naturally occurring red-fleshed apples

Using Genomics Information to transform the development of new cultivars

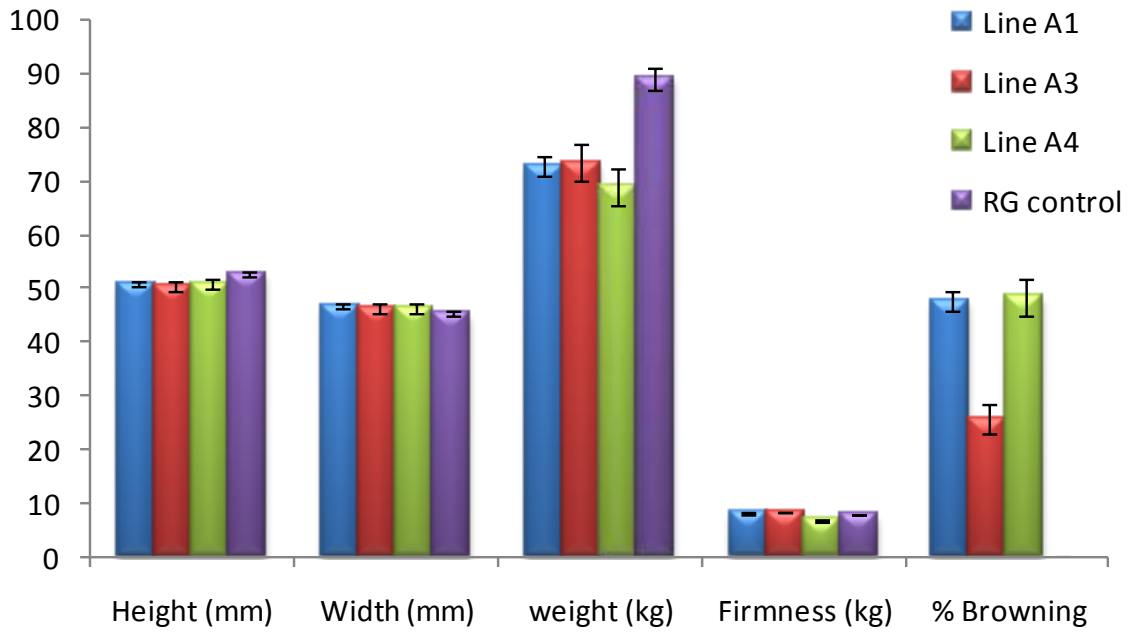
Techniques:

- Biotech breeding
- Faster breeding
- Novel breeding

Accelerating the production of fruit



MYB10 Fruit phenotype

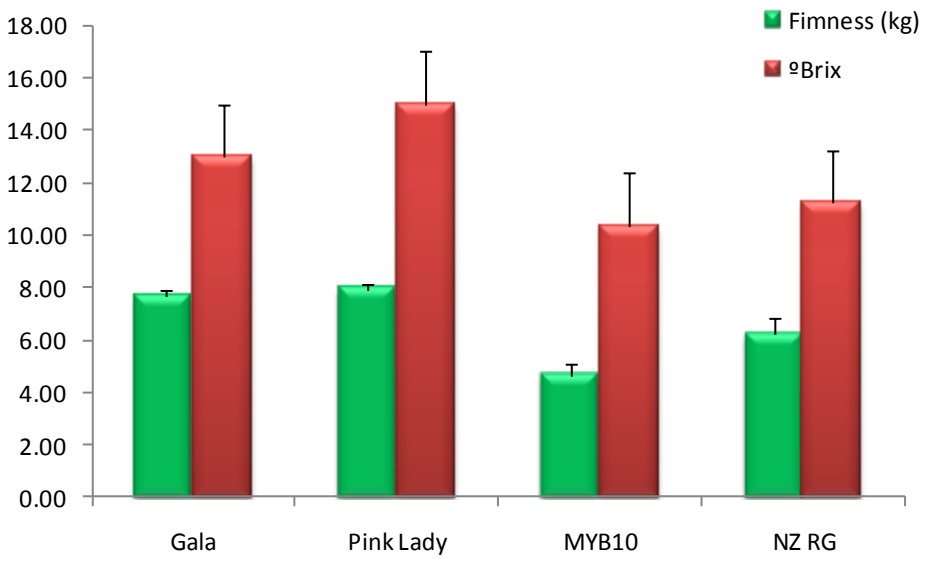


Sensory trial

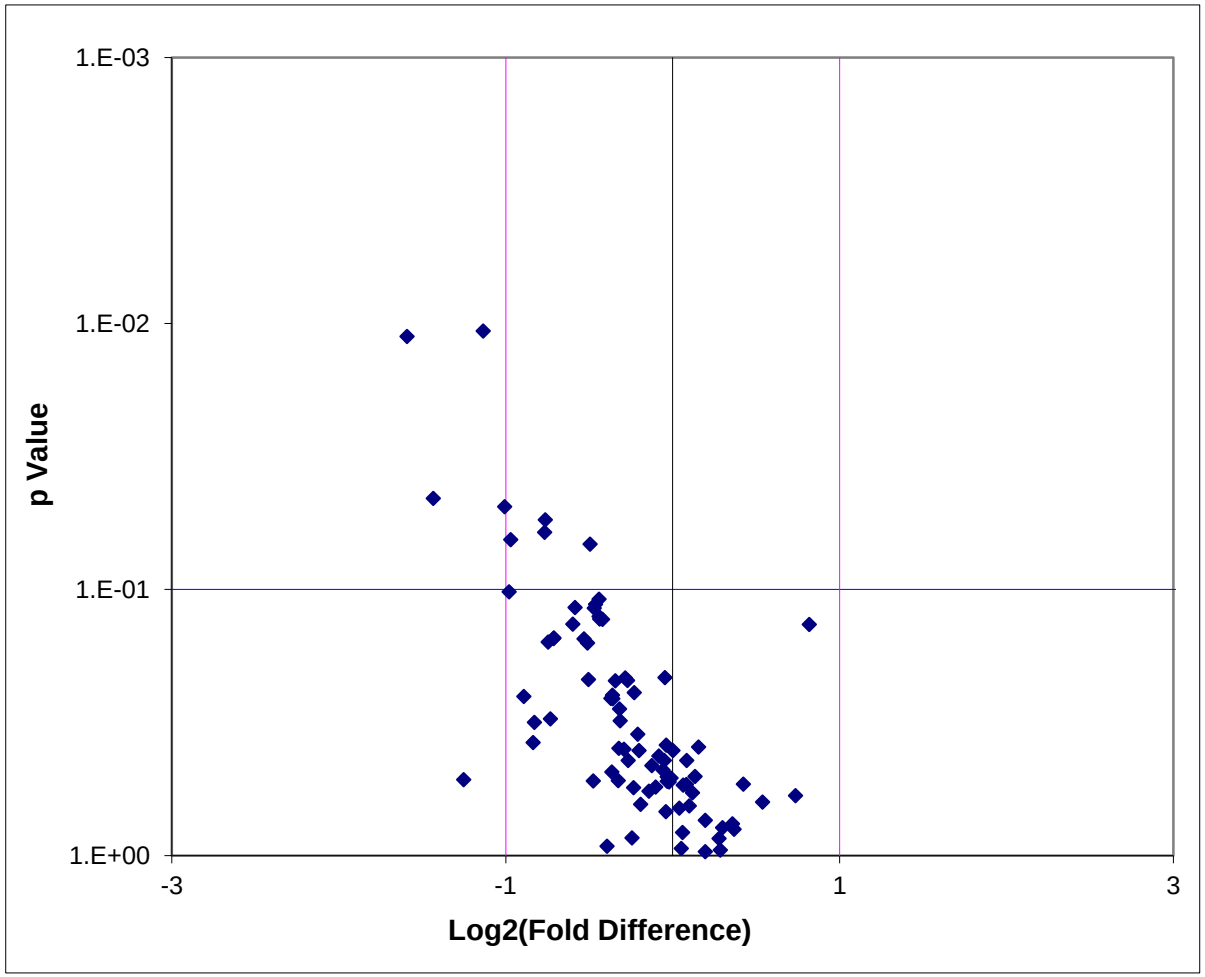
Hypothesis:

MYB10 apples taste the same as Royal Gala.
There is no direct link between colour and astringency.

- California - 50 screened panellists
  (gender, age, diet, ethnicity, income etc)
- Double blind x 4 sets

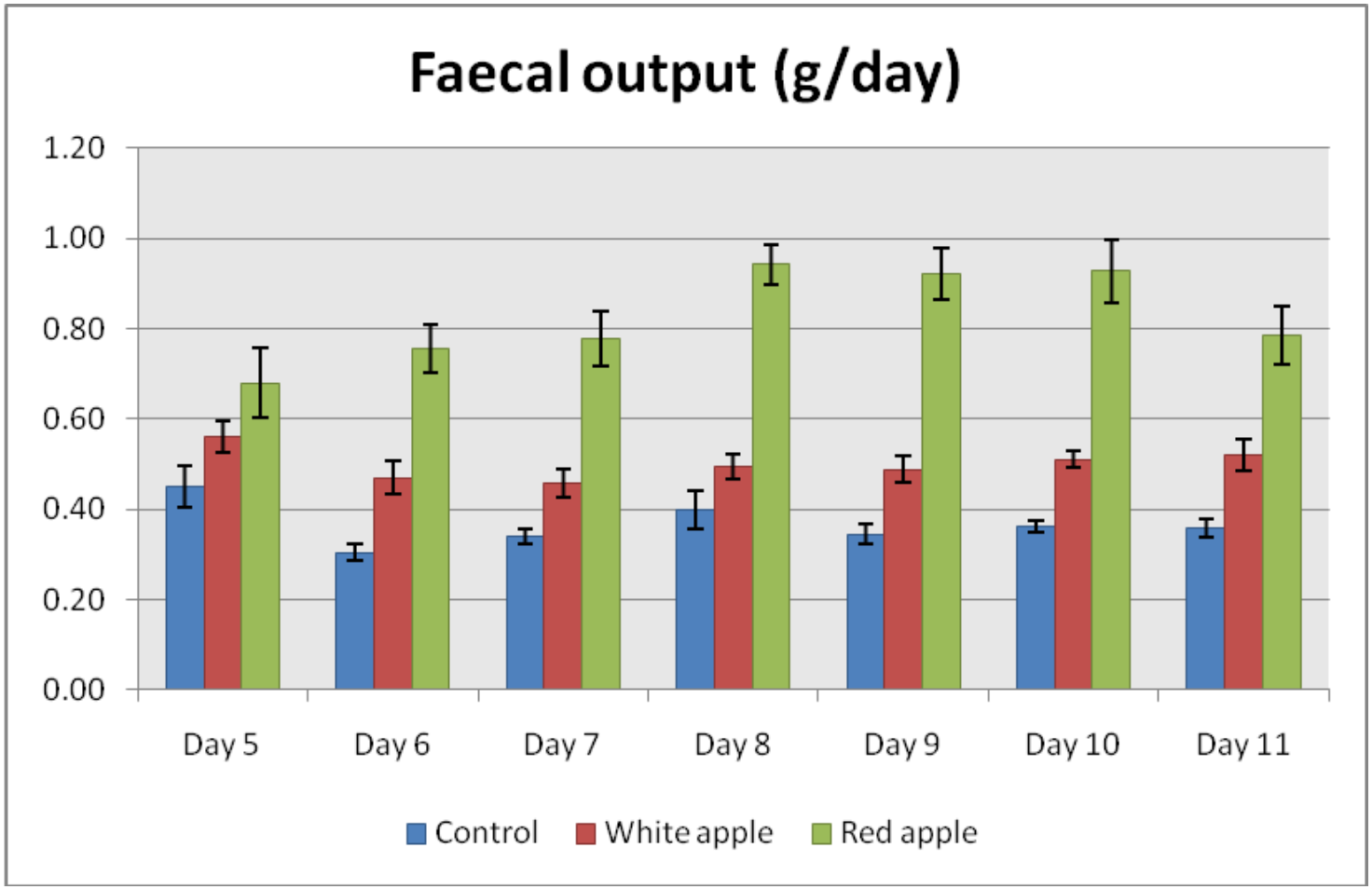


Changes in gene expression – inflammatory pathway



Chemokine (C-C motif) receptor 2 (Ccr2), Chemokine (C-X-C motif) ligand 10 (Cxcl10) and Chemokine (C-C motif) receptor 10 (Ccr10) showed fold increases in relative gene expression of 2.2, 2.4 and 2.7 respectively

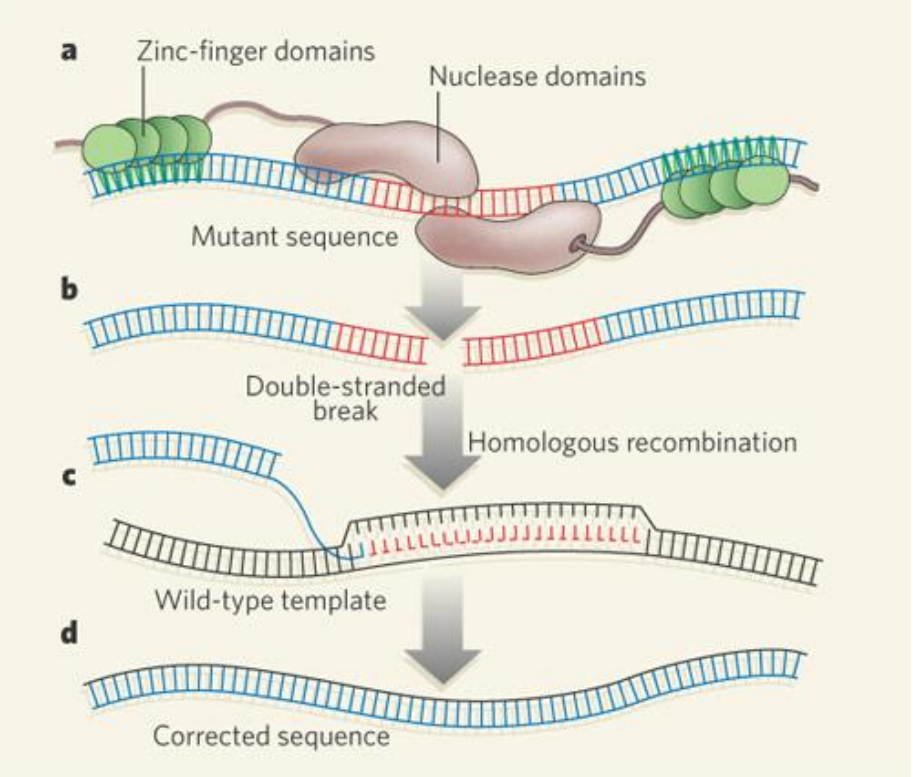
Significant change in faecal output



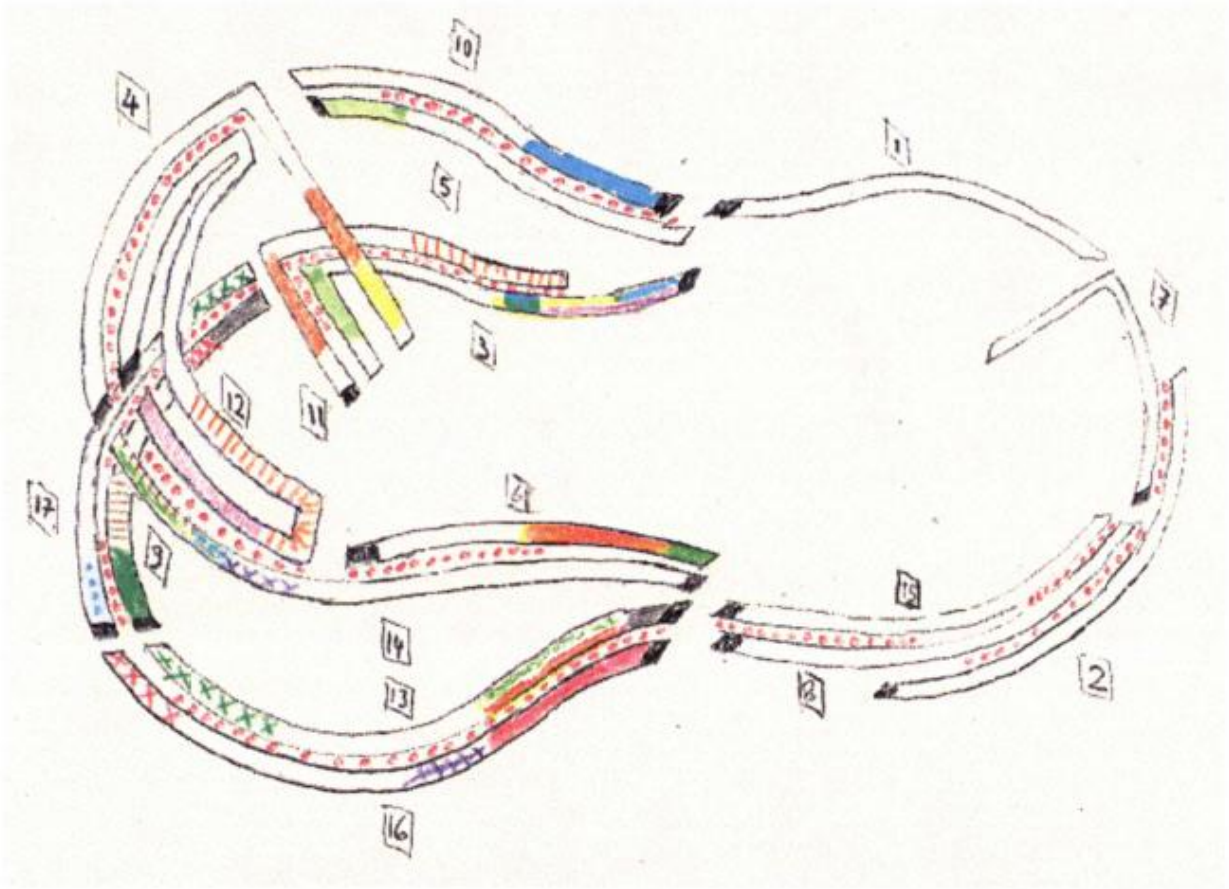
Emerging techniques in biotech

techniques

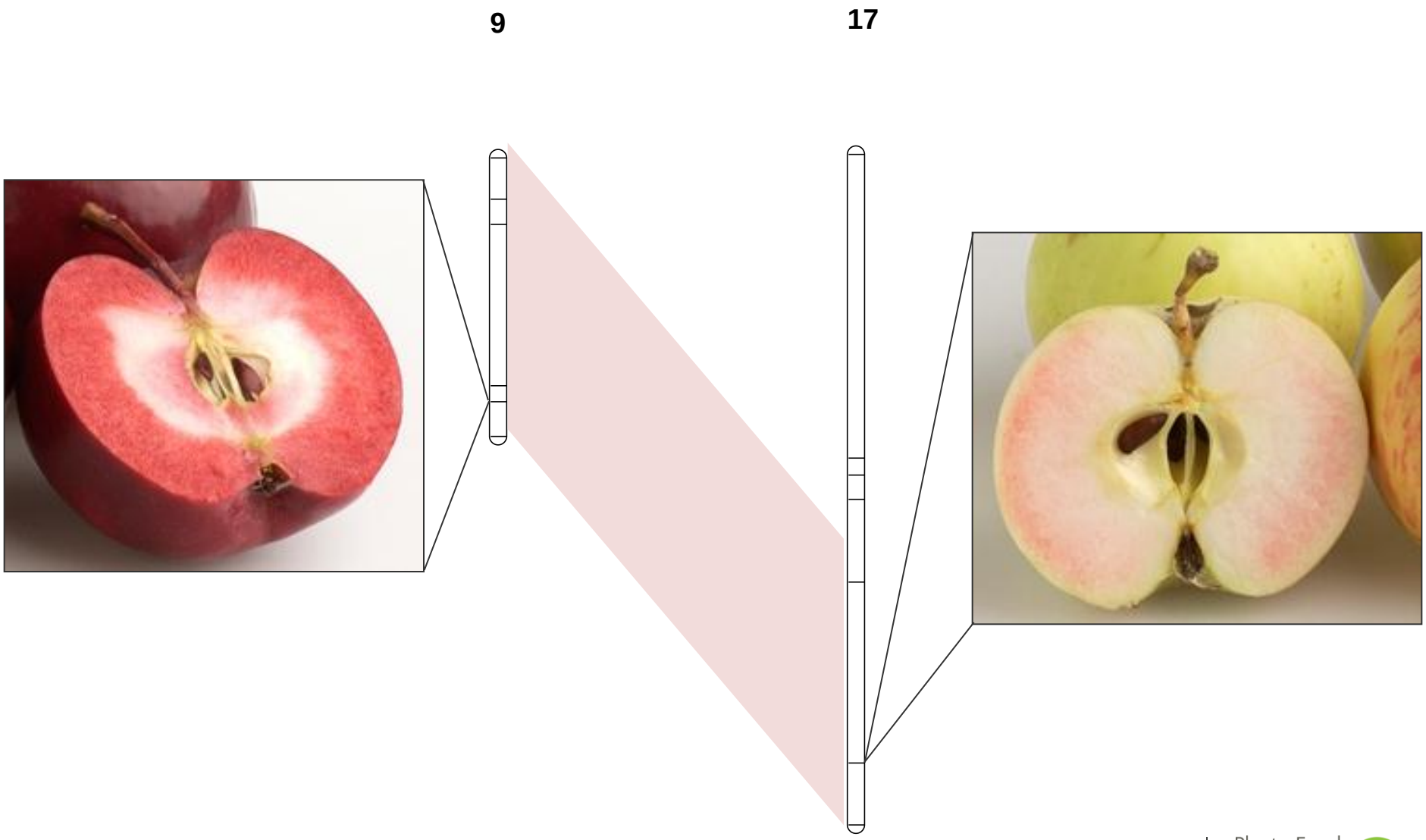
- Homologous recombination
- Zink finger nuclease
- Mutagenic oligonucleotides



Conventional mapping approaches benefit from functional gene knowledge - Duplication in Apple



Chromosomes Duplication in Apple

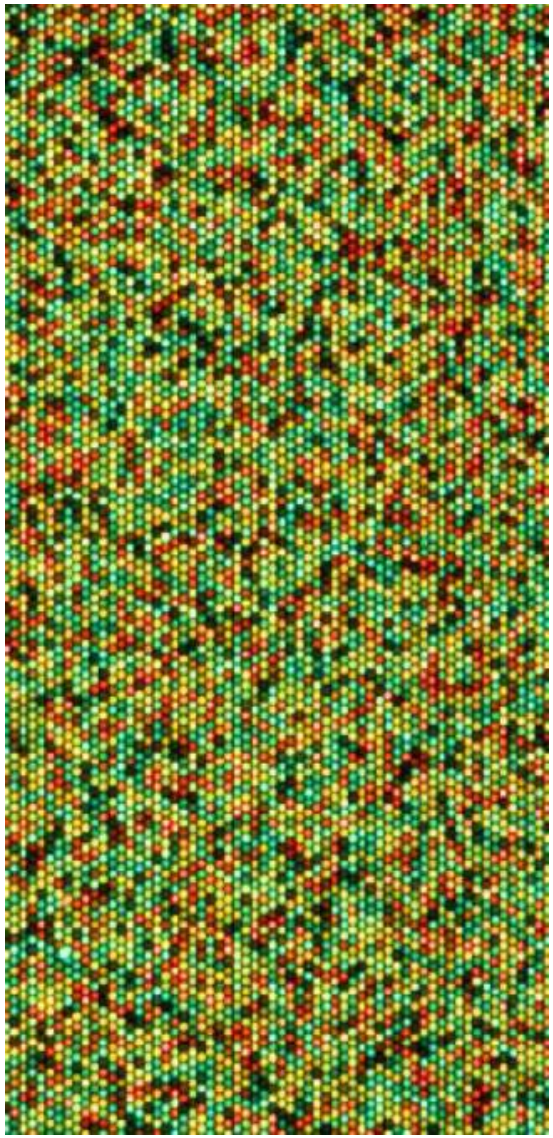


Next generation mapping techniques

techniques

Marker assisted selection of major genes

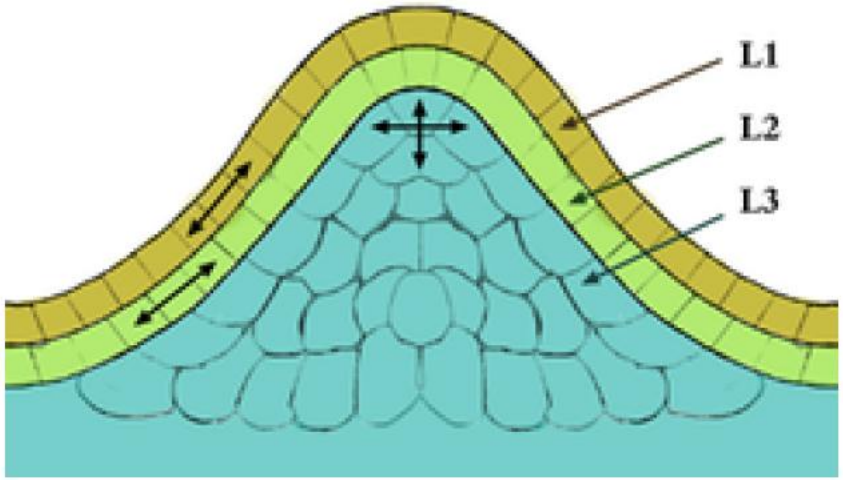
Genome wide selection for complex commercial traits



Somoclonal breeding

Grape

- Vegetative propagation for 250 years.
- Accumulate mutation in L1, L2 and L3.
- Layer invasion to develop now cultivars with out crossing.



no alleles	average no loci	unfiltered
1	1,865,412	5,881,814
2	4,364,015	9,097,120
3	45,856	197,751
4	1,940	9,227

Developing germplasm

techniques

- Mutagenasis
- TILLING
- Transposon activation

Summary

- Translational genomics in real plants
  - genes to alleles
- Genomics to tests novel concepts
- MAS is the reality for even minor crops
- NGS is making everything possible

Acknowledgements

Genomes
Ross Crowhurst
Roy Storey
Mark Fires
Cecilia Deng
Elena Hilario

Apples Resequencing
David Chagne
Charmaine Carlisle

Red Apples
Andy Allan
Richard Espley
Kui Lin-Wang
Sumathi Tomes
Christina Bava
Chrissie Butts

Vitamin C
Marcela Martinez-Sanchez
William Laing
Sean Bulley
Michele Wright

Carotenoids
Charles Ampomah-Dwamena

Dwarfing
Toshi Foster

Flavour
Edwige Souleyre;
Daryl Rowan

Mappers
David Chagne
Mark McNeilage

Genomics Platform

Collaborators
ISAMS, PRI, PGC – BGI

The New Zealand Institute for Plant & Food Research Limited

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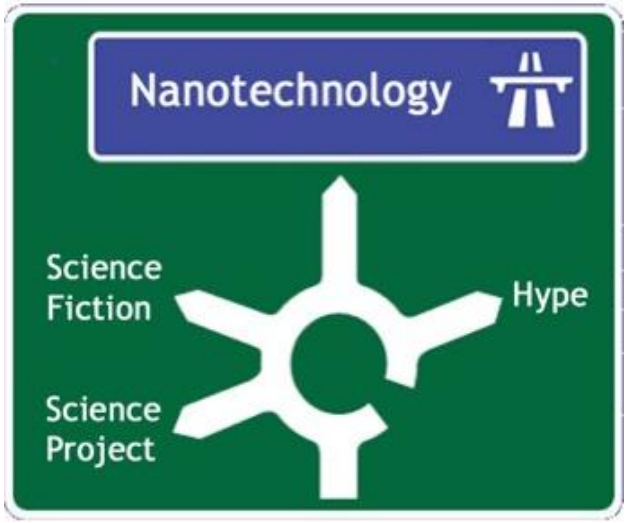
Applications of Nanotechnology to Agricultural Practice



Terry Turney
Sonic Essentials Pty Ltd
&
Centre for Green Chemistry
Monash University

terry@sonicessentials.com

Nanotechnology - What is it?

"Nanotechnology is the creation and use of materials, devices and systems which exploit novel properties arising from the structure and function in the nanometre range"

- Size does matter
  - A strand of hair is 10,000 nm
  - Surface effects start to dominate
  - At <5nm also quantum effects are found

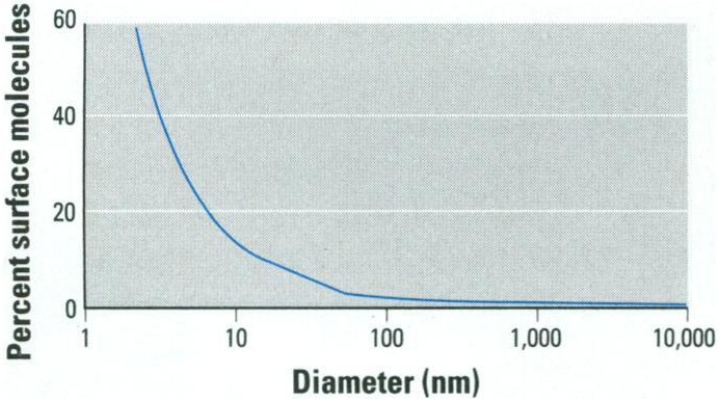
1 nanometre

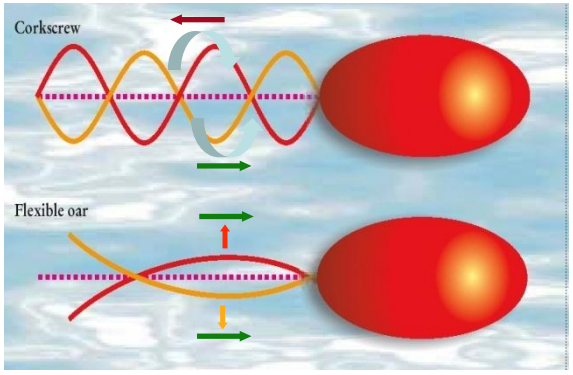
1 metre

What's Different about the Nanoscale?

- **When you get really small – new effects can appear**
  - Quantum effects

  - Nanoparticles are dominated by their surface properties





- Viscosity – water appears 1,000,000X more viscous to a bacterium than to us

Nanotechnology in Farming Practices

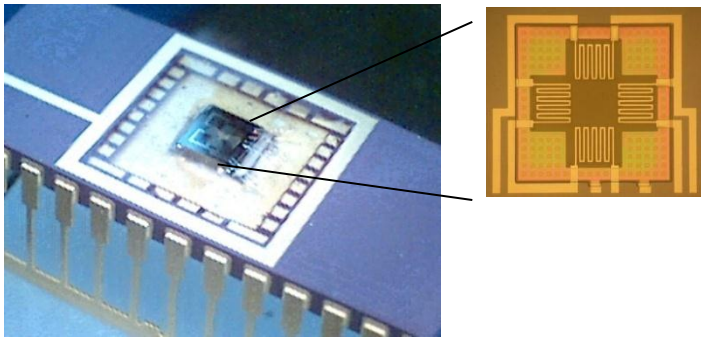
- Applications to the agriculture and food sector are relatively recent compared with use in drug delivery, pharmaceuticals and new materials

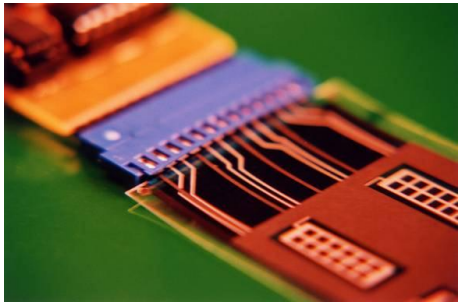
- **Environmental Sensors**
- **Intelligent Packaging**
- **Controlled Release**
- **Enhanced Plant Growth**

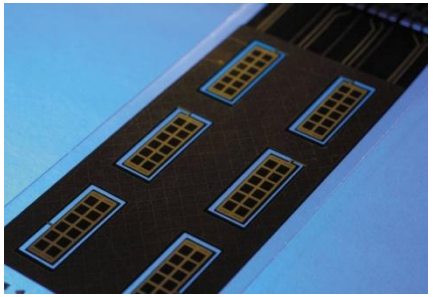
Ultra-Low Cost Sensors

Light - Temperature - Humidity - Wind speed - Wind direction - Salinity

- Low cost disposable electronic weather station
- Wireless communication
- Precision agriculture
- Water management
- Healthier high value crops
- Global market



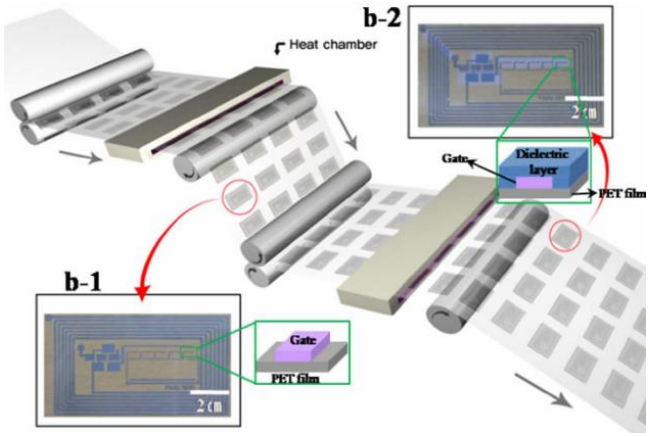


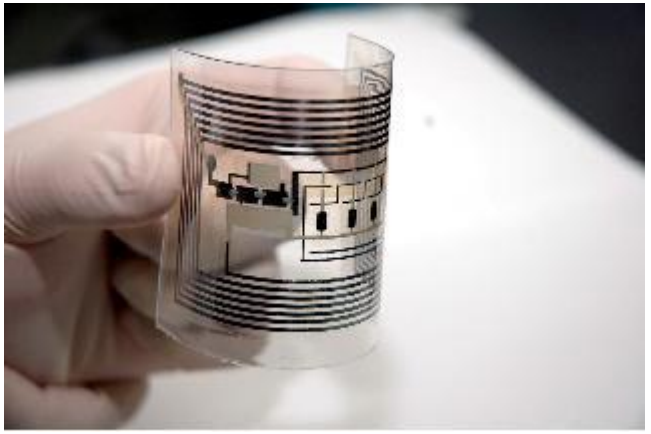


Soil moisture sensor - Printed polymer

Printable Electronics – Low Cost Manufacturing

- Ink-jet or roll-to-roll printing
  - Chipless circuits
  - Power sources (batteries)
  - Size not critical
  - Nanoparticle inks
  - Home-based standard printers
  - Printable RFIDs
  - Interrogated via mobile phone “apps”?



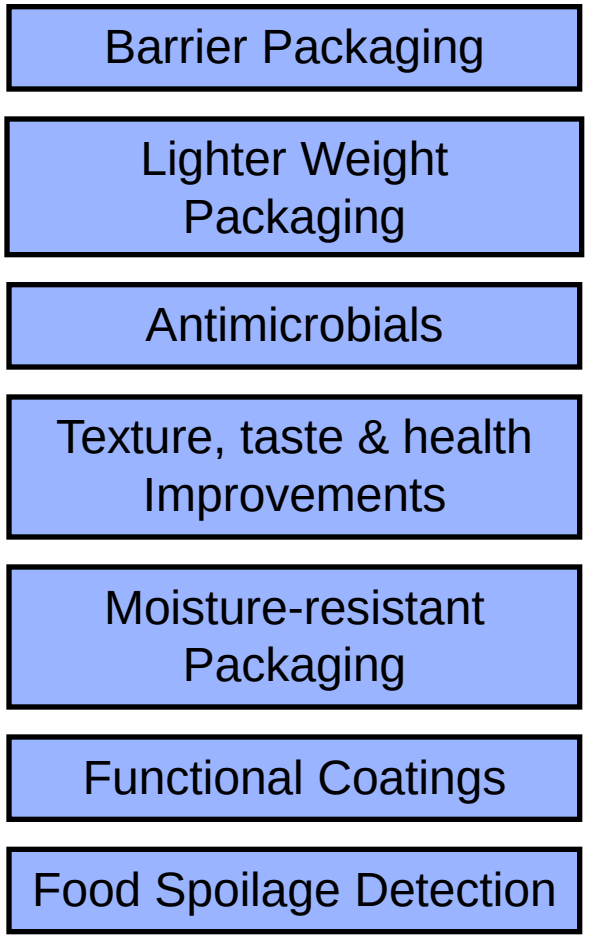


Integration with Printable Electronics

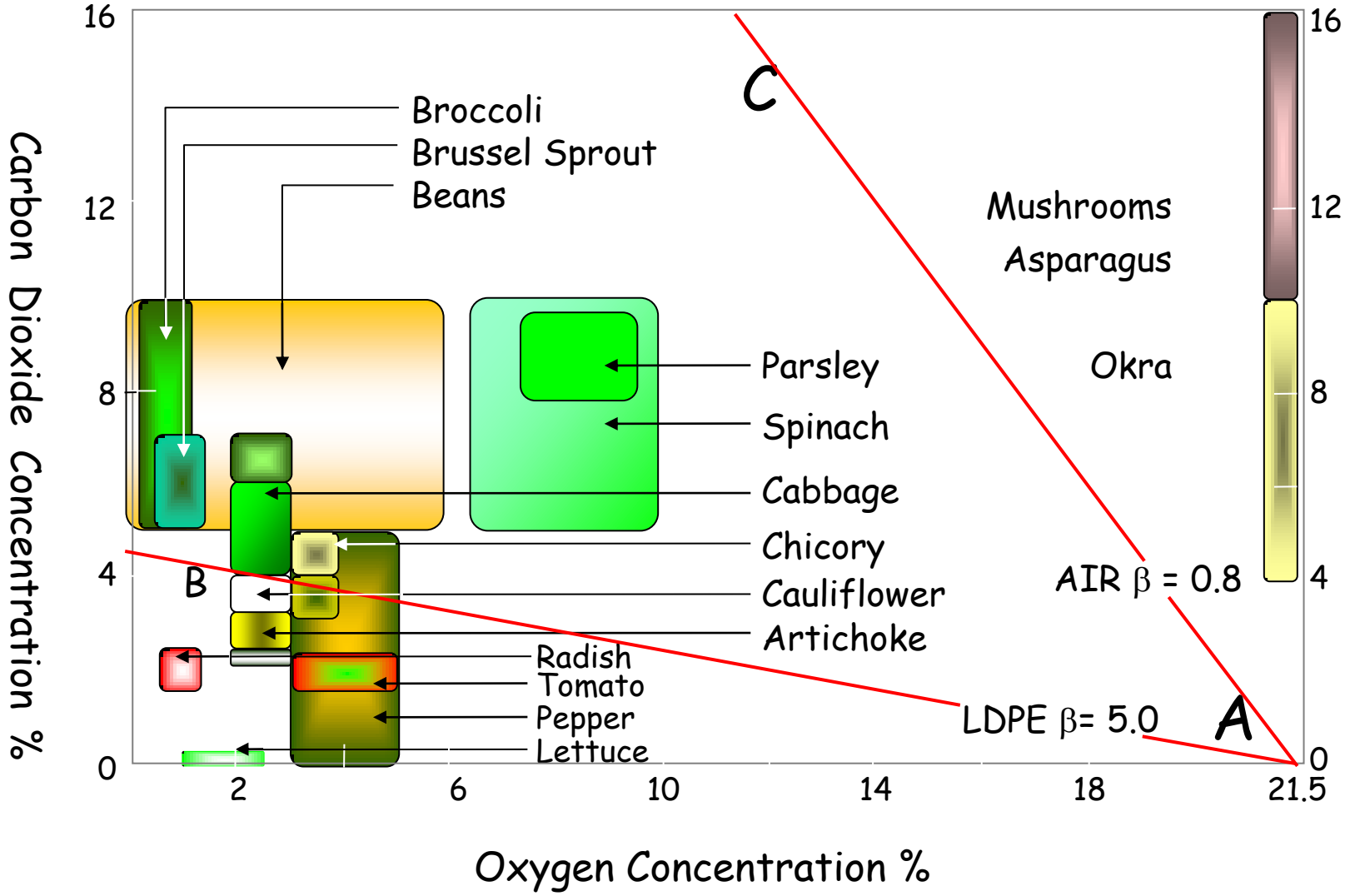
- Time-temperature, microbiological and gas indicators
- Integrate with an RFID to carry condition history and other data
- Advent of ultra low-cost chipless devices (ie, printed electronics)
  - Could be interrogated via mobile phone “apps”?
- Barriers still remain for smart printable devices
  - Market not yet developed
  - Multiplicity of available formats
  - UHF interference and signal distance
  - Interpretation of data

Nanotechnology in Packaging

- Potential benefits include:
  - Better durability
  - Better usability
  - Stronger branding
  - Higher added value
  - Increased sustainability
  - Embedding “intelligence”
    - Sense contents or environment
    - Supply chain management



Optimum Storage Atmospheres for Vegetables



Packaging

- ‘Breathable Film’ technology
  - Permeability increase for packaging of fresh produce
  - One film stock - a range of permeabilities
- Control of ripening processes and fungal attack
- Nanocomposite packaging film - layered hydrotalcite-based additive + micro/macroporous inorganic additive
  - Controls O_2/CO_2 packaging atmosphere and reduces C_2H_4 <50 ppb

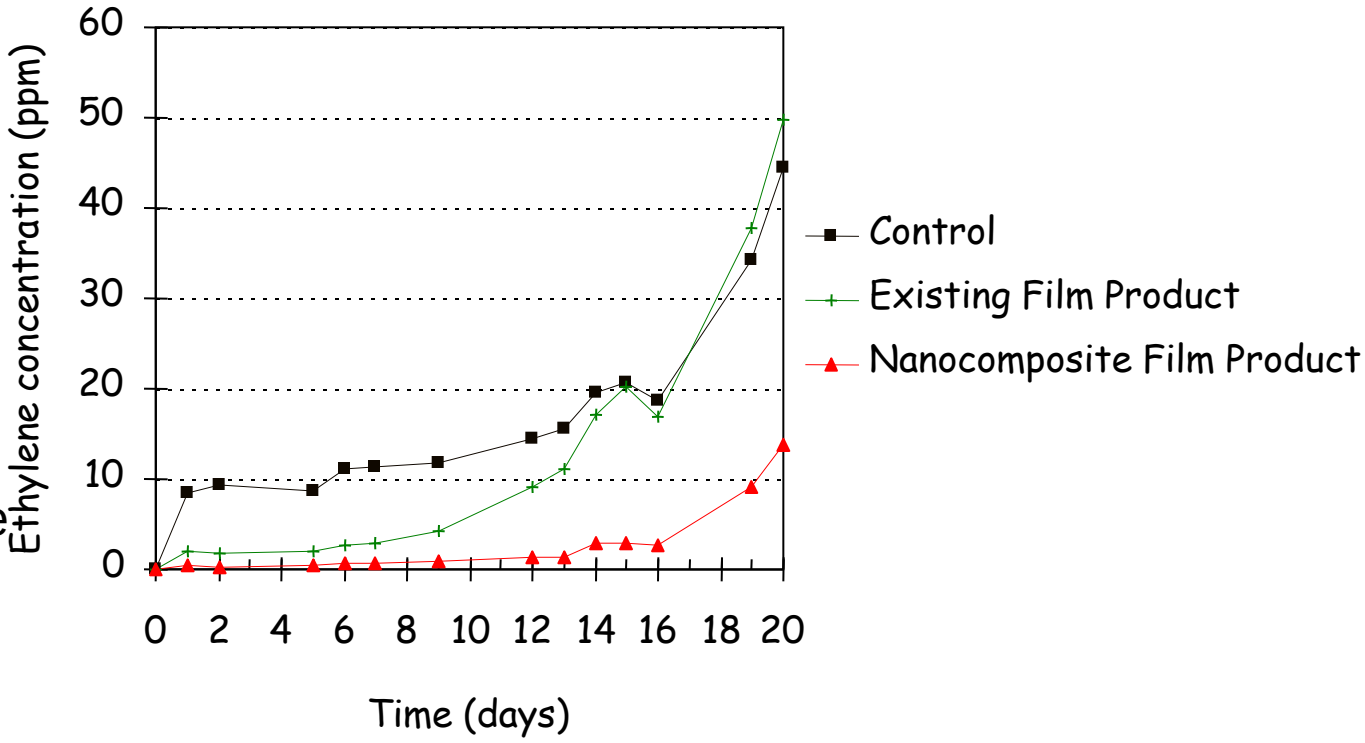
Storage of Fresh Produce

Ethylene Concentration in Polymer Nanocomposite Bags

Pears after 13 days at 0ºC, 7 days at 10ºC

Nanocomposite packaging film - layered hydrotalcite-based additive + micro/macroporous inorganic additive

Controls O_2/CO_2 packaging atmosphere and reduces C_2H_4 <50 ppb

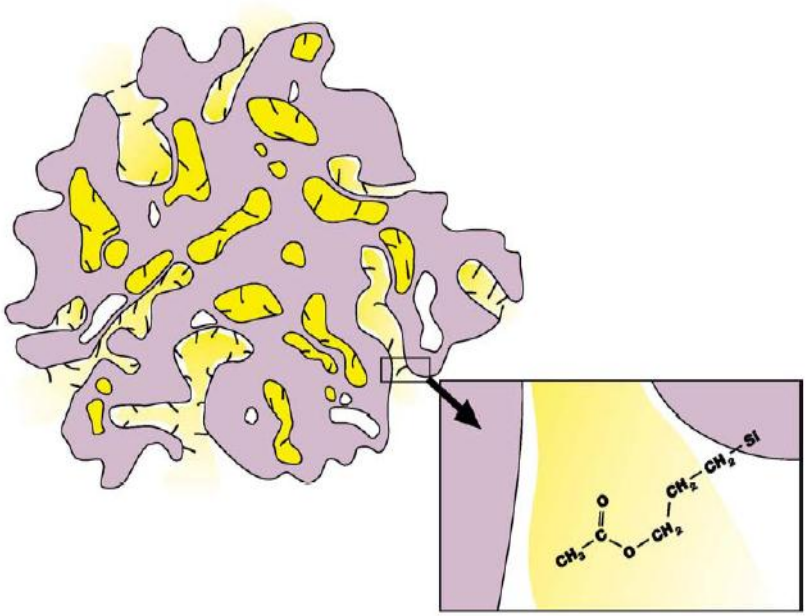


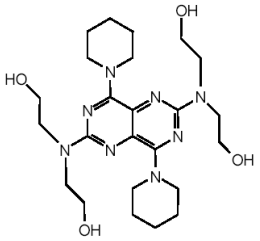
CSIRO technology

Controlled Release and Scrubbing

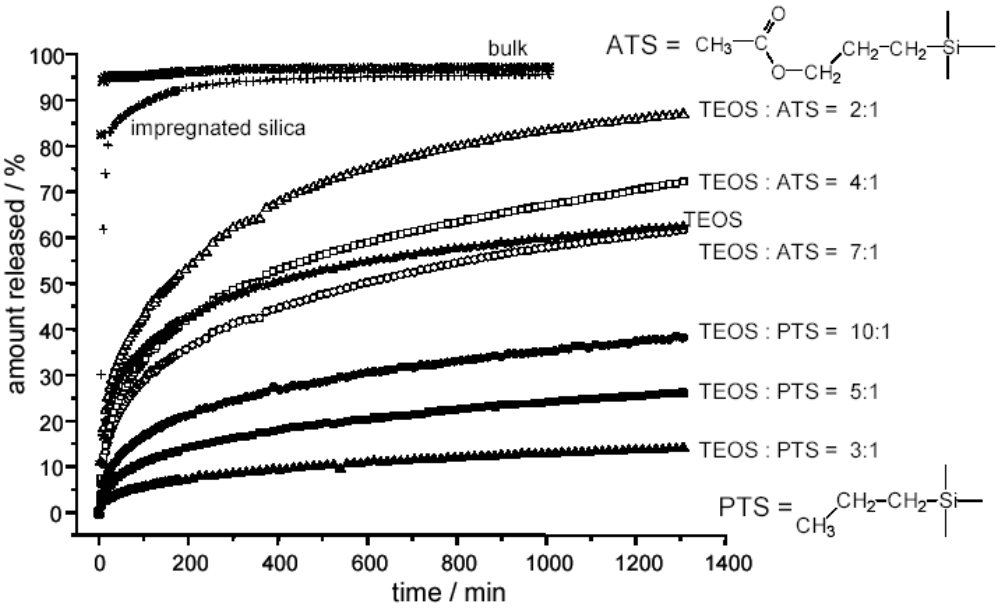
- Use of nanosized pores in solids to release or trap bioactive materials
  - Controlled delivery of pesticides, fertilizers and growth hormones for plants
  - Real time, on-demand, automated & precise
  - Reduced costs and minimised chemical release into environment
  - Removal of contaminants in water

Gated Delivery Systems





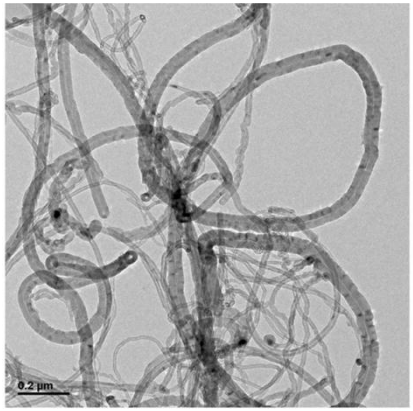
Active molecule
- Persantin



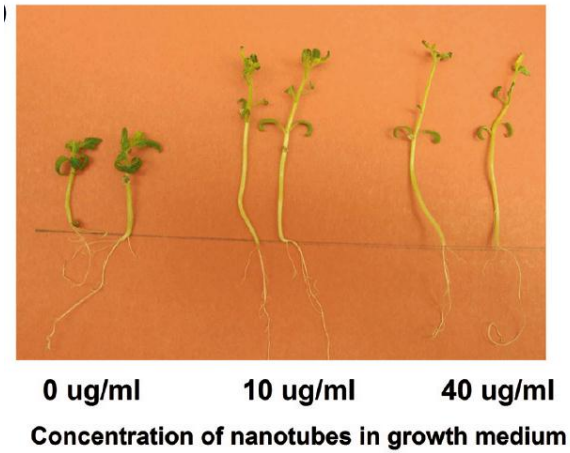
- Controlled delivery through control of nanoporous reservoirs and using “molecular gates” at pore entrances
- Use for foods, medicine, veterinary, cosmetics, agriculture.

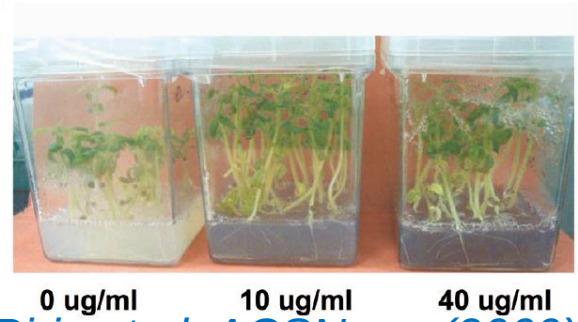
Pas, Hill et al (Univ. Munster/CSIRO)

Enhanced Plant Growth



- Carbon nanotubes (CNTs) can penetrate seeds and affect their germination and growth rates.
  - CNTs (10-40g/1000 L) are able to support water uptake inside seeds, a process which can affect seed germination and growth of tomato seedlings.
  - Increased root length in ryegrass
  - Germination rate, shoot and root growth in mustard seeds
  - Up-regulation of genes related to stress, heat shock and water channels





Biris et al ACSNano (2009)

Future of Nanotechnology in Food Production

- Food scarcity will be **THE** global issue of 2020
  - Major opportunity for Australia to improve both quantity and quality of our produce
  - 500,000 children die each year from Zn deficiency
- Nanotechnology has a role to play in improving the efficiency of our food production
  - Embedding intelligent devices in farming
  - Improving crop yield through controlled release
  - Improving crop quality by improved agronomic practices

"Those who avoid new remedies can expect new evils, for time is the greatest innovator."
Francis Bacon

Crop processing Innovations

Addressing future needs of Australian vegetable industry

Dr. Mala Gamage| Research Project Leader

9 May2012

Value chain & CFNS research experience

Pre planting Stage
Planting material disinfection

Growing stage

Harvesting

Postharvest stage
Insect disinfestation

Processing
Novel technologies/products
Full / minimal processing

Logistics and Marketing
- Export
- Interstate

Consumer
Understanding consumer needs

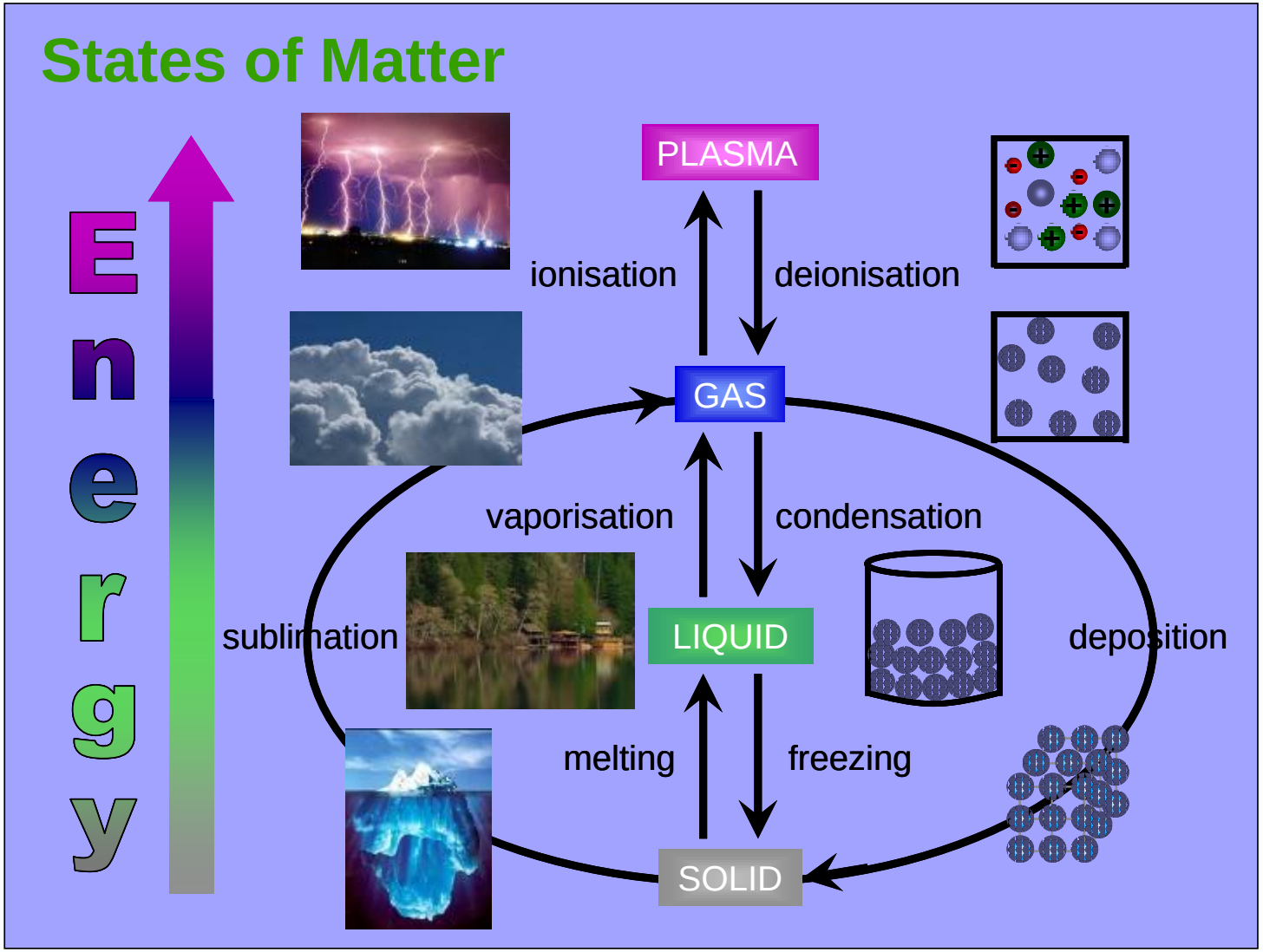
Surface decontamination of seeds, tubers and planting material

Options:

Cool Plasma and

Low energy electron beam

What is cool plasma?

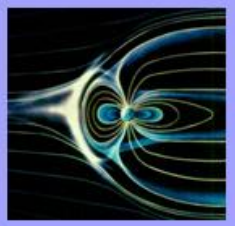


What is cool plasma?

Cool plasma is partially ionised gas at 30-60°C

- Induced in gas by imparting energy i.e. electrical discharge, radio frequencies, microwaves
- Partially ionised gases at < 60°C, energy <10 eV, components do not penetrate matter
- Plasma reverts to non-ionised gas (e.g., air, oxygen, nitrogen, argon etc)
- Low pressure – fewer collisions of atoms keeping temperature of plasma < 60°C
- Atmospheric pressure – more collisions, but short impulses of energy source prevent plasma from heating up (<60°C)

Plasma species



Heat

Electromagnetic field

UV radiation

Plasma

Visible light

Charged ions and electrons

Atoms free radicals

Cool plasma for microbial inactivation

Examples

Food items -

nuts
milk powders,
herbs and spices

Packaging material -

foils, wraps, pouches

Advantage

Relatively short exposure time required

Lower overall energy requirement

No chemical residues

Minimal surface change

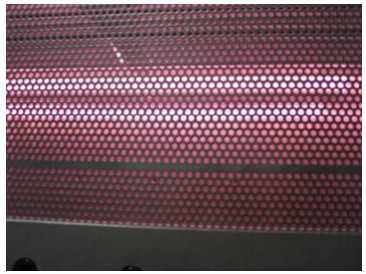
Current limitations

- Depth of penetration
- Scaling up
- Potential surface oxidation leading to limited application
- Need to conduct research in this area of study

Cool Plasma – Equipment at CSIRO

Petri dish size sample port

Lab-scale low pressure unit

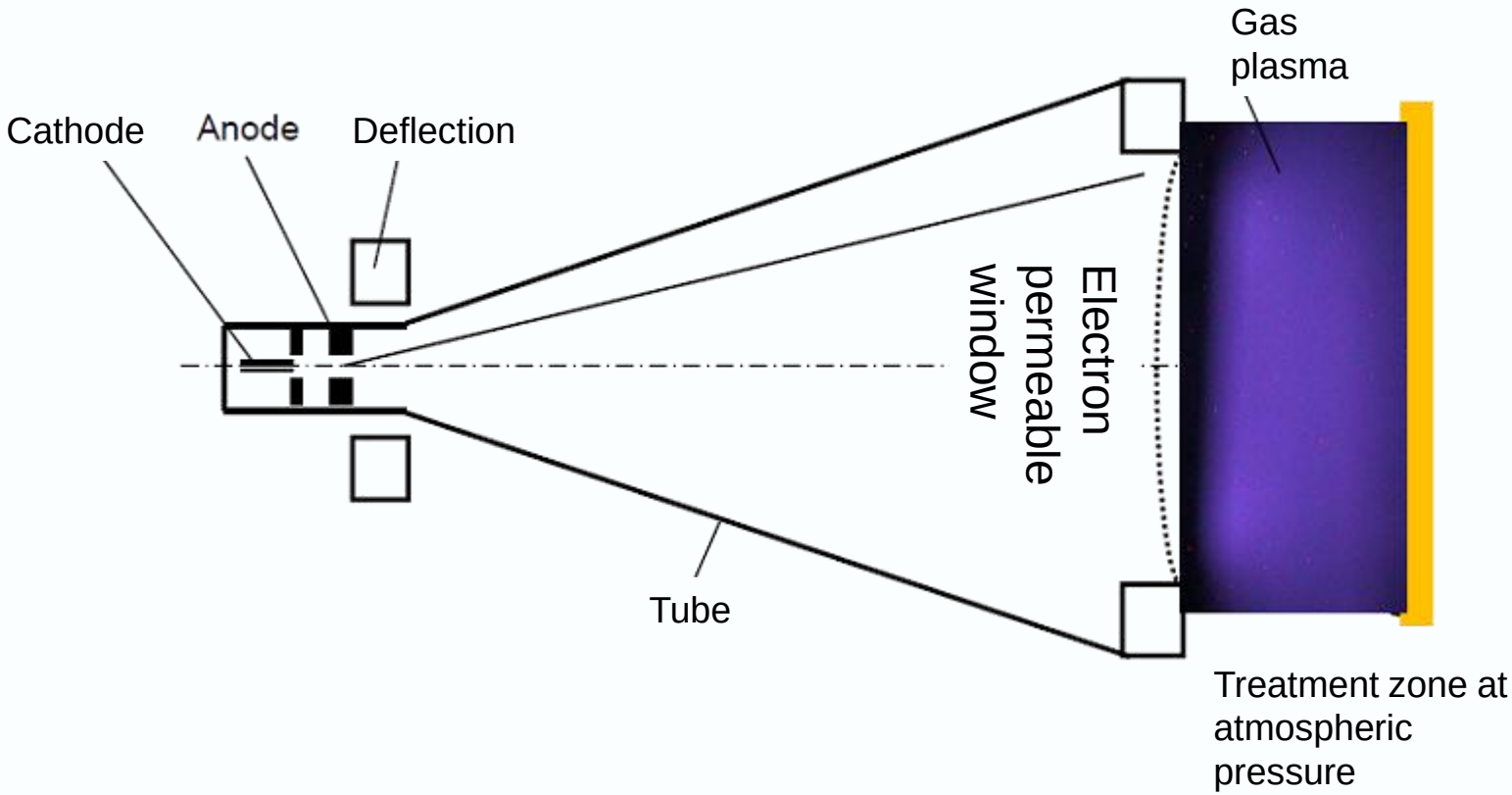


Pilot-scale low pressure unit

Lab-scale atmospheric pressure unit

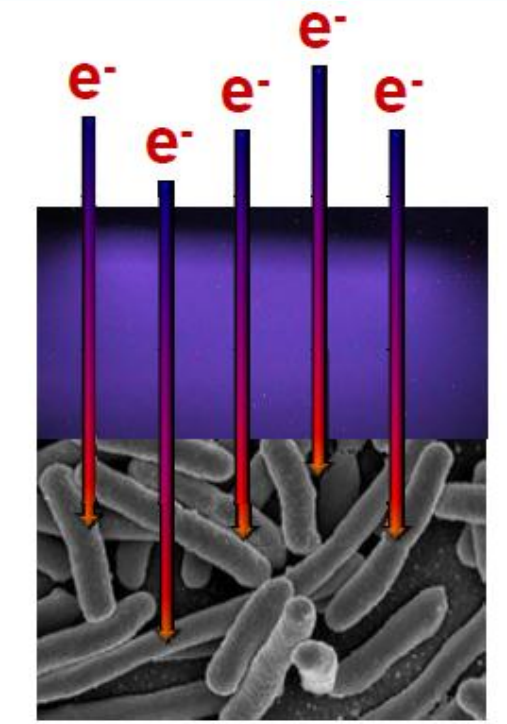
Low energy electron beams – Basics

Electron Beams at atmospheric pressure (similar to CRT TVs)



Low energy electron beams – Mechanisms

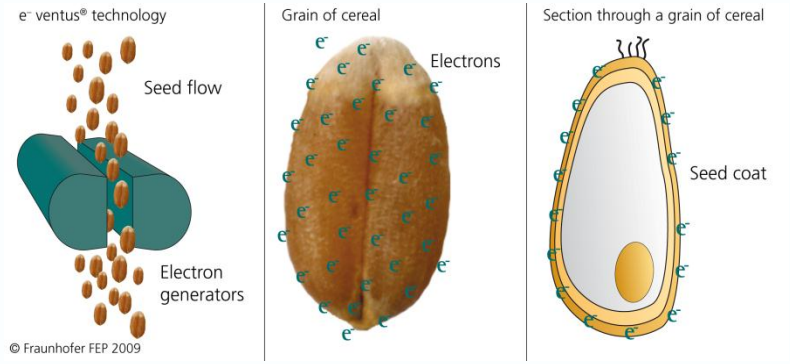
- Electrons are absorbed by the material
- Penetration depth is adjustable (up to 500 µm)
- Excitation and ionisation of molecules
- Secondary reactions through radicals and ions
- Destruction of bacterial cells and spores, no known repair mechanisms



Electron beam on E. coli
(Fraunhofer FEP, 2009)

Low energy electron beams – Applications

- Seed dressing, for conventional and organic seeds mainly in Europe
- Sterilisation of packaging material
- Disinfection of pharmaceutical bulk goods



Application for grain seed dressing

(Fraunhofer FEP, 2009)

Application for pecans

(CSIRO FNS, 2010)

Equipment access through collaboration

CSIRO has collaborative research relationship with

1. The Fraunhofer Association in Germany (Institute for Electron Beam and Plasma Technology) and
2. Evonta Service GmbH

Pilot-scale unit at FEP (Dresden, Germany)

Mobile commercial-scale unit at BayWa (Seed processor, Hainichen, Germany); owned by Evonta GmbH

Fraunhofer FEP

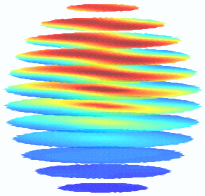
EVONTA

Postharvest insect disinfestation

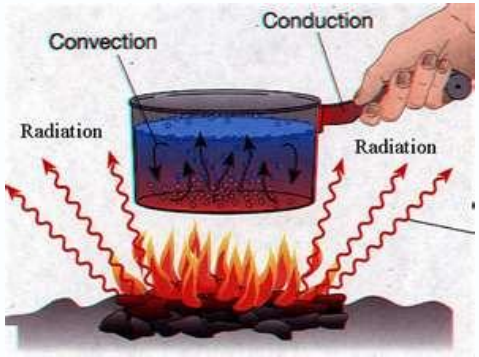
Option:

Microwave processing

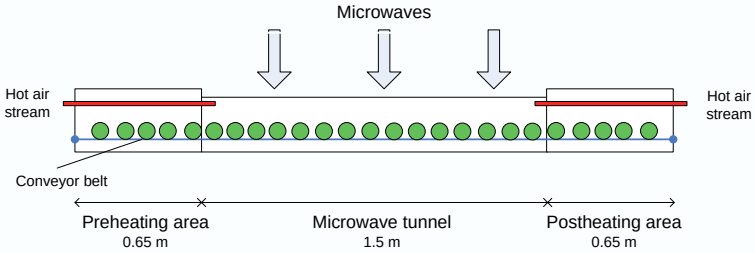
Microwave (MW) heating



MW Volumetric heating

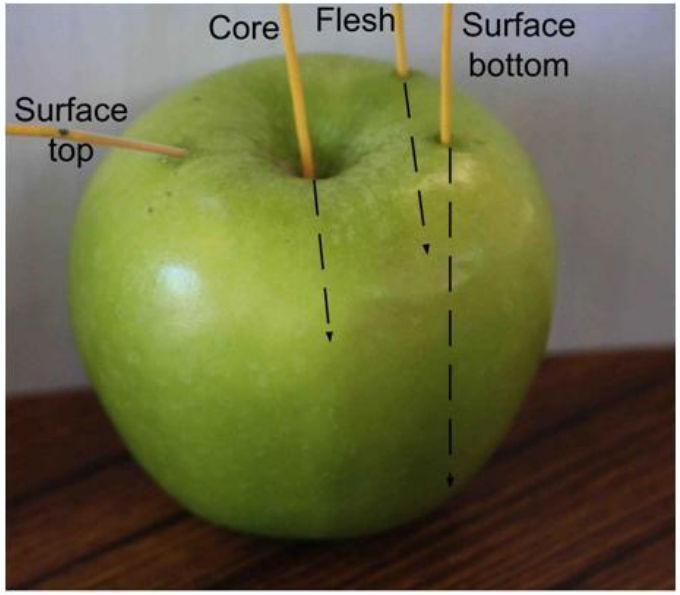


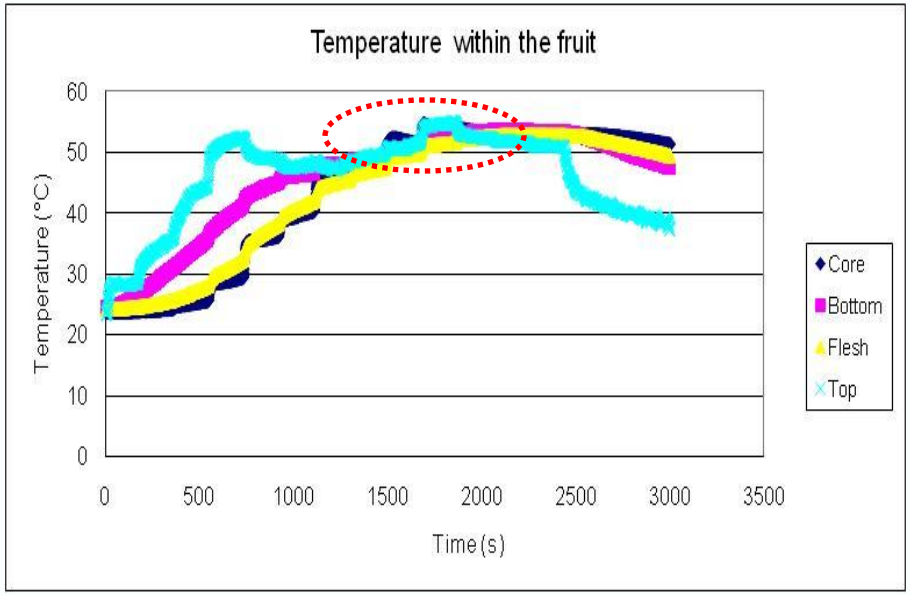
Conventional heating methods



Pentagonal
MW + hot air tunnel
for
continuous treatment of fruit

Microwave (MW) heating of horticultural products





MW treatment of insect infested apples - Insect mortality

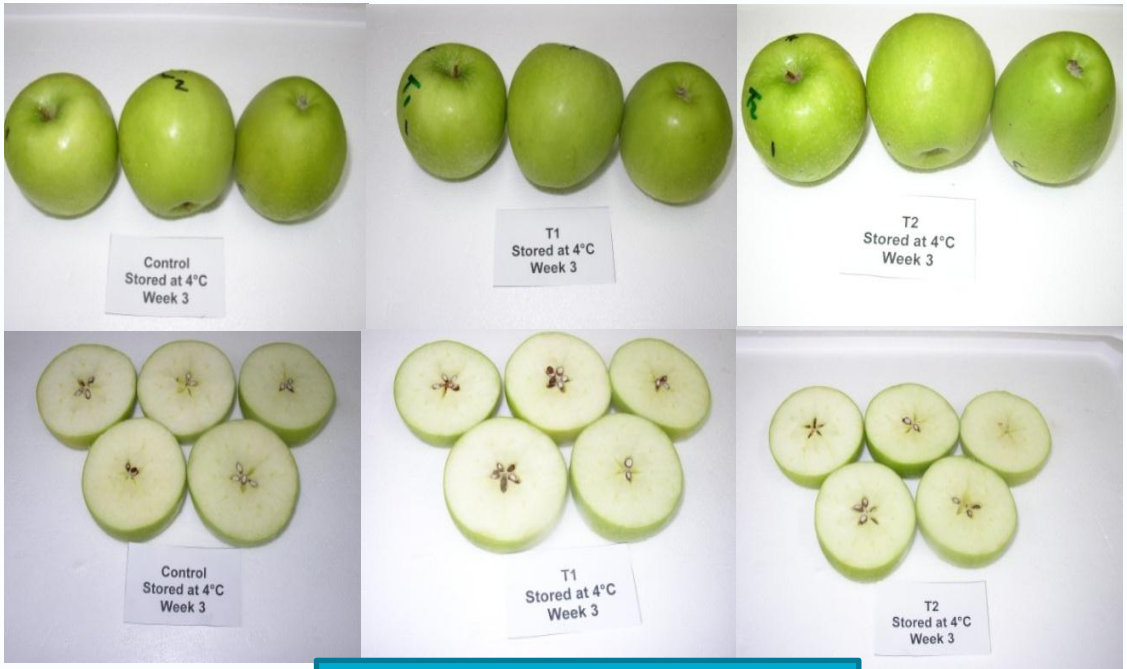
Insect	Treatment	Mortality of insects %	Average maximum fruit temperature °C
Apple codling moth *(Cydia pomonella)*	T1	97.7	51.7
	T2	98.3	52.3
DPIV	**T3**	**100**	55.0
Queensland fruit fly *(B. tryoni)*	**T3**	**100**	55.1
	T3	**100**	56.3
DEEDI	**T3**	**100**	56.0
Jarvis fly *(B. Jarvisi)*	T3	99.9	54.9
	T3	**100**	55.4
(Most heat resistant fruit fly)	**T4**	**100**	56.8
	T5	**100**	56.8
	T6	**100**	54.5
DEEDI	T6	97.6	52.9

Quality of MW treated apples - I

Treatments

- Control - untreated apples
- T1 – MW + hydro cooling to 4°C
- T2 – MW + cooling at 22°C

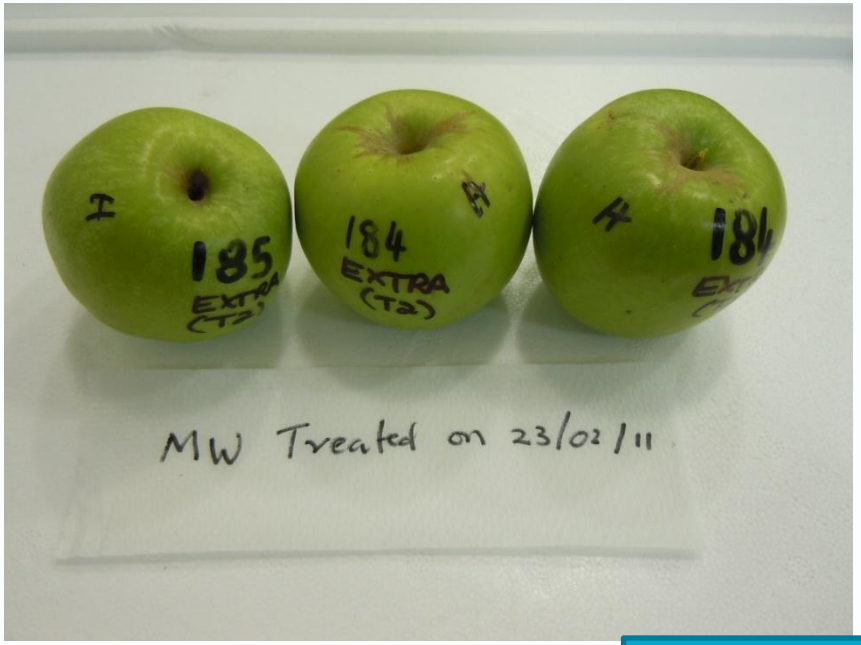
4 weeks storage at 4°C



Granny Smith apples

Quality evaluation of MW treated apples – II

External appearance after MW treatment



Internal appearance after MW treatment

Organic Mutsu apples

Microwave (MW) heating of horticultural products

Advantages

Microwave/hot air heating - high potential →

- **Need further optimisation / validation**
- **Use can be extended to many crops,**
- **Short treatment time (MW 72s, total time 54 min)**
- **Direct energy absorption,**
- **Free of chemical residues,**
- **Suitable for small and large pack houses.**

Fruit quality was not affected by MW treatment

Future work

- **Target crops – Calcium, Zucchini?**
- **Insects – Fruit flies**
- **Proof of concept disinfestation & quality trials**
- **Collaborations – CSIRO &DEEDI**
- **Funding – AUSVEG, HAL & CSIRO**

Processing

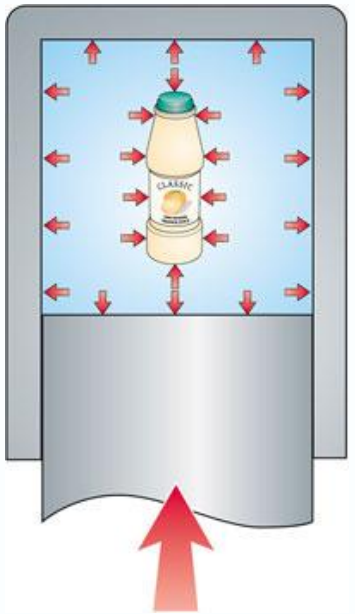
Option:

High pressure processing

Texture improvement prior to processing

Ultrasonics assisted drying

High pressure processing



- Emerging food preservation technology
  - Inactivates vegetative microorganisms at room temperature
  - Results high retention of quality (flavour, nutrients etc)
- HPP at P≥ 300 MPa can cause irreversible changes in
  - the structure of proteins
  - may lead to inactivation/activation of enzymes
- HPP at commercially feasible condition (P≤600MPa, 3-5min)

- Can be used for, sliced, diced and pureed vegetables

→ Better retention of Nutrients, flavour, texture and consistency compared to heat

Products in Australian market

Preshafruit

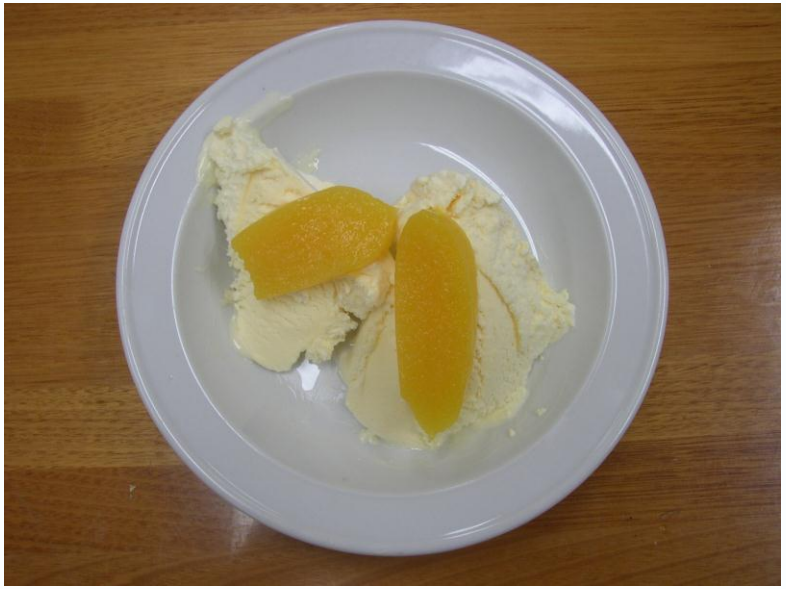
Pressure Fresh AUSTRALIA

moira mac's

CSIRO

High pressure processing for restructuring of fruit products

- Novel structured products can be produced



Re-structured fruit products

Ultrasonic processing

•The application of sound waves at frequencies higher than the audible range (>16 kHz)

• Cavitation: formation, growth & implosion of tiny gas bubbles in liquid

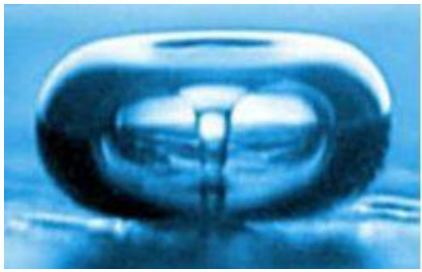
  • the basis for the application of ultrasound in processing

  • implosion of bubbles- localized extreme increase in T(1000K), P (500MPa)

  • stable cavitating bubbles create strong microstreaming and shear affecting the quaternary & tertiary structure of proteins

  • Cavitation leads to homolysis of H_2O molecules & formation of $H^{+\cdot}$ & $OH^{-\cdot}$

•

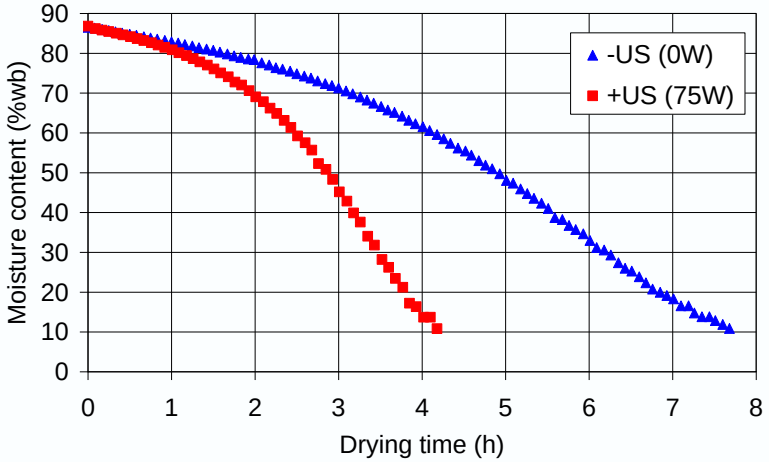


Ultrasonic-assisted drying

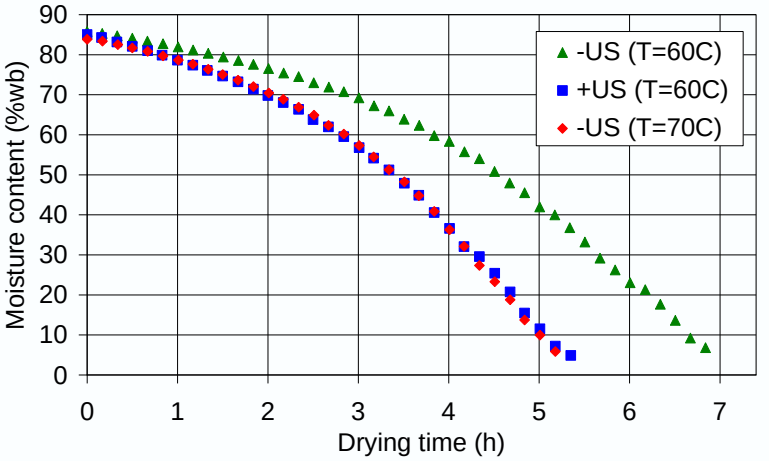
Photo of the ultrasonic-assisted test dryer

Outcome:

- Up to 50% reduction in drying time (i.e. reduce energy use and increase throughput) depending on process variables
- Better product quality and functionality



Effect of ultrasound on drying kinetics of apple (T=40°C; RH=25%; V=1.0m/s; 5mm slices).



Effect of ultrasound on drying kinetics of apple (US Power=75W; RH=25%; V=1.0m/s; 5mm slices).

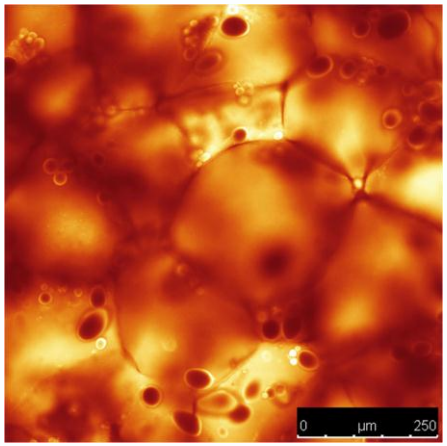
Low intensity ultrasound

- Pre-treatment of some plant tissues – e.g. potato

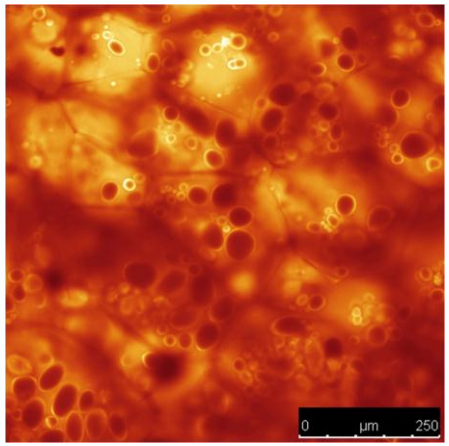
  - results in better firmness and crispiness after further processing by thermal sterilization or freezing etc

Low intensity ultrasound pre-treatment

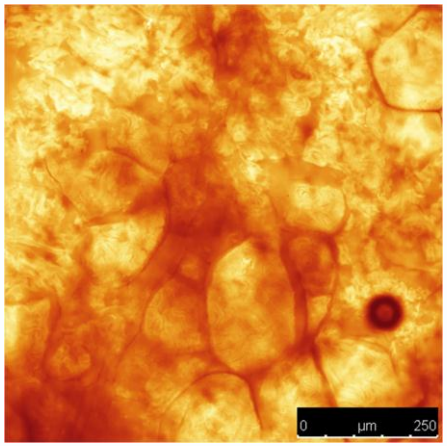
Effect on microstructure



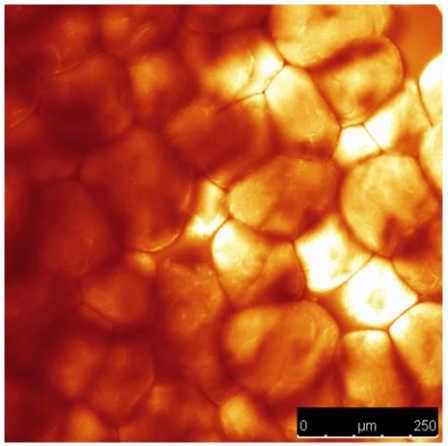
Untreated



US treated unblanched



Untreated blanched



US treated blanched

US pre-treatment: 40 kHz at 40 °C for 5min
Blanching: 100 °C, 5 min

- Significant increase in crunchiness
- Reduced tissue disruption after blanching

Waste utilization

Option:

Bioactive extraction

CSIRO Bioactives Library

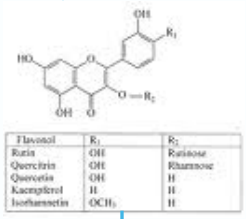
Sustainability - Extracting Value from Waste Streams

Seeds

Pomace

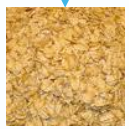
Oil

Protein



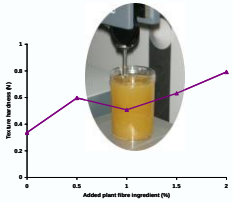
Phytochemical Extract / Fraction

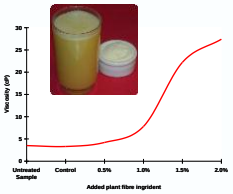
Soluble Fibre



Insoluble Fibre

Bioactive Fibre



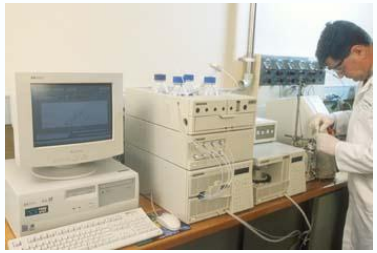


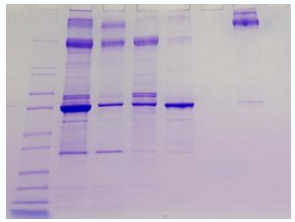
CFNS Separations Capability - Strengths
Laboratory bench to Commercialisation

Feed / problem characterisation → Laboratory scale separation → Scale up to pilot → Size commercial process → Commercial process commissioning

Process economic and risk sensitivity analysis

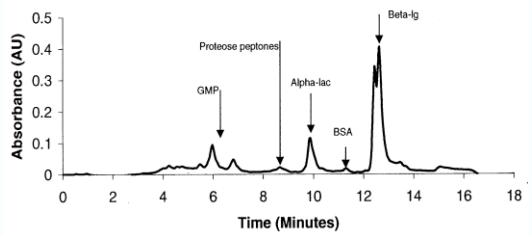
μL - mL

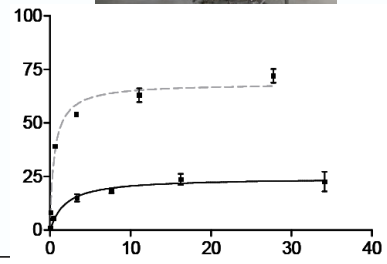




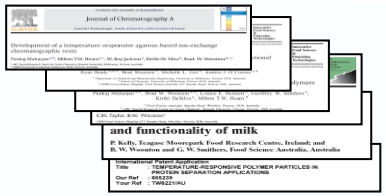
10mL - 1L

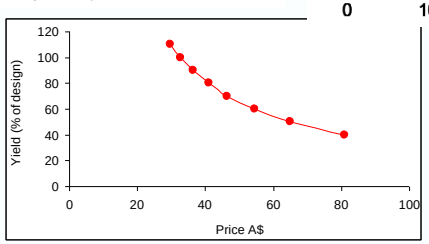
100L – 10kL

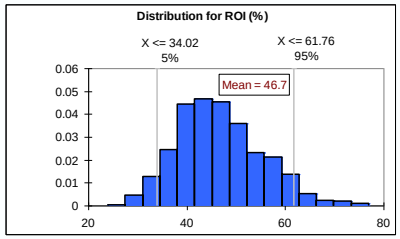




10kL – 1ML



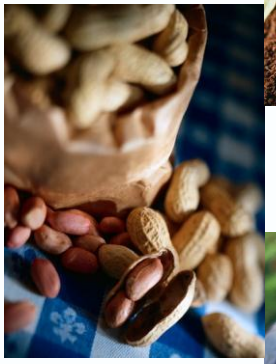


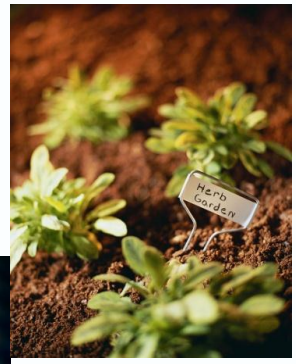


CSIRO Food Plant Library

Plant Library
(n~200 substrates)

- Edible
- 'Australian diet'
  - herbs
  - nuts
  - grains
  - fruits
  - vegetables
  - fungi





Opportunity for consideration

Very broad capacity for regulation of salt balance by dietary plants via Renin-Angiotensin System (Patten et al, accepted; Patten et al submitted)

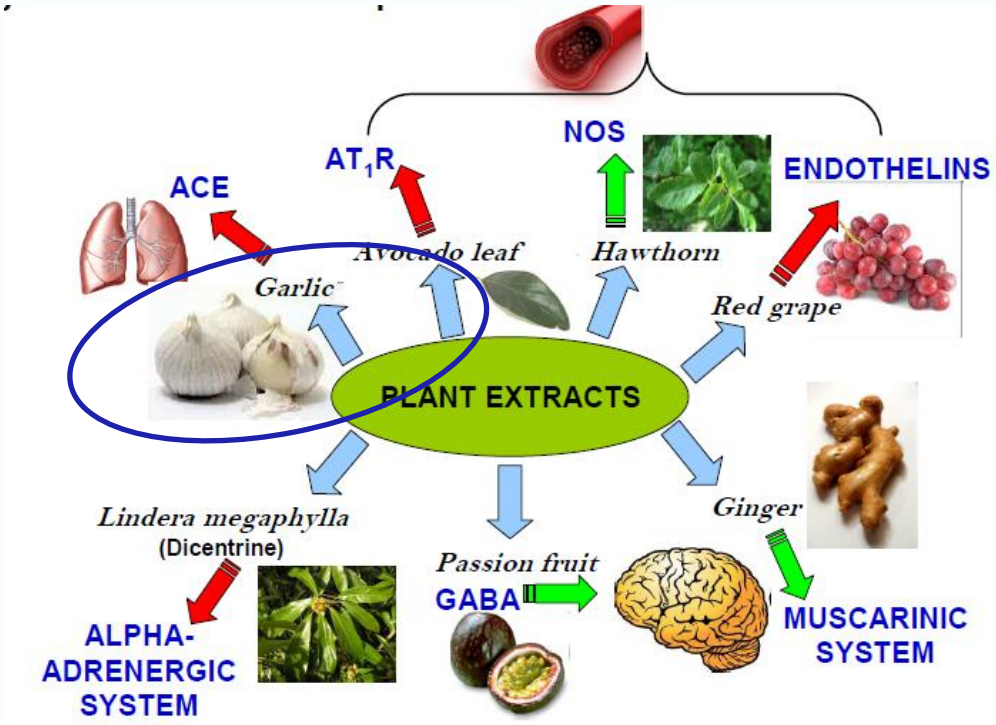
New research shows that RAS (enzyme and receptor system) is active in the gut, so absorption of bioactives is not required)

Significant potential for plants (including herbs) to regulate blood pressure by stimulating salt excretion

Potential application for sub-therapeutic benefit in blood pressure regulation

- Professor Simon Stewart Head of Preventative Health at the Baker Heart and Diabetes Institute, who led the five year study, 'Pressure Points in Primary Care' Radio National Broadcast: Thursday 16 February 2012 6:48AM

Blood pressure regulation by (All) Plants



Plant bioactives are used in traditional medicine to lower BP by RAAS and other systems

In vitro efficacy for:

- **ACE inhibition activity (74 plant families)**
- **AT_1 receptor blocking activity (16 plant families)**

***In vivo* efficacy for lowering blood pressure in various normotensive or hypertensive animal models by the oral route in 43 plant families (72 species).**

In vivo efficacy for lowering human BP in plant 15 families (19 species)

Patten et al (accepted) Critical Reviews of Food Science and Nutrition

Summary

Stage in value chain	Technology	Stage of technology development
Treatment of planting material	Cool plasma	Laboratory scale
	Low power electron beam	Ready for commercialisation 
Insect disinfestation	Microwave disinfestation	Semi pilot scale experimentation
Processing	High pressure	Ready for commercialisation 
	Ultrasound pre-treatments	Laboratory scale
	Minimal processing (fresh cuts)*	Knowledge base available
Waste utilisation	Extraction of bioactives & functionality	Knowledge base and equipment available 
Understanding Consumer needs	Consumer science capabilities*	Readily available knowledge base and facilities

Acknowledgement

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Dr. Raymond Mawson

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Mr. Lloyd Simons

Dr. Cornelis (Kees) Versteeg

DEEDI

Mr Peter Leach

DPIV

Mr. David Williams

Dr. Ragini Wheatcroft

Thank you

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w www.csiro.au/fns

Future Technologies in Agriculture

Sam Birrell, Netafim Agronomist

AUSVEG Conference Hobart 2012

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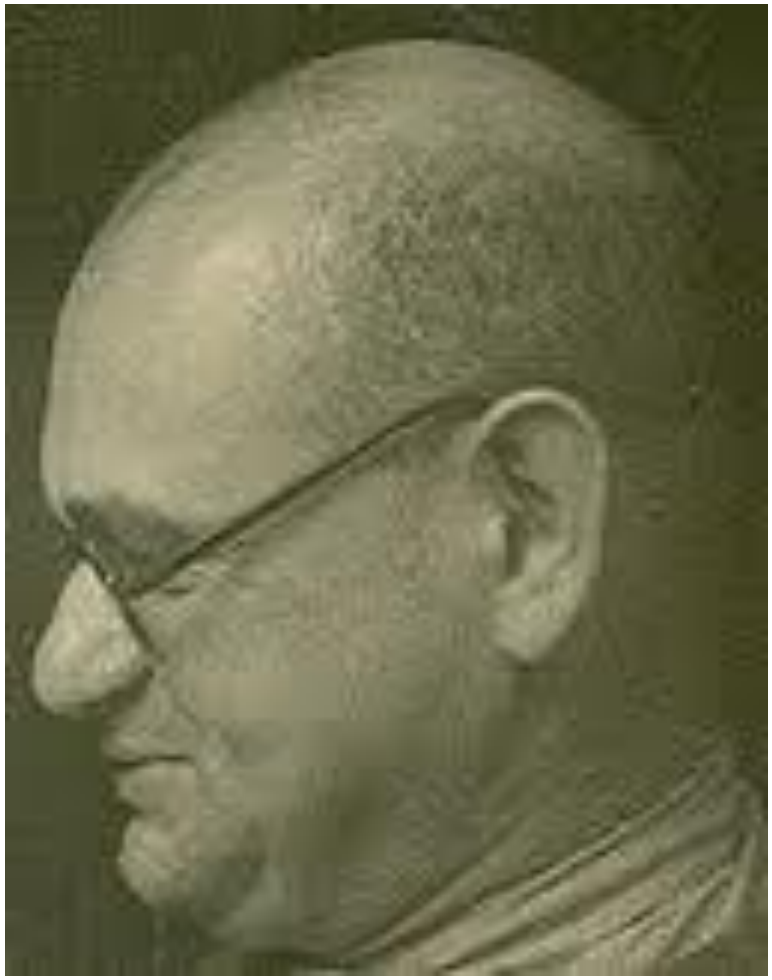
INPUTS

OUTPUTS

Netafim

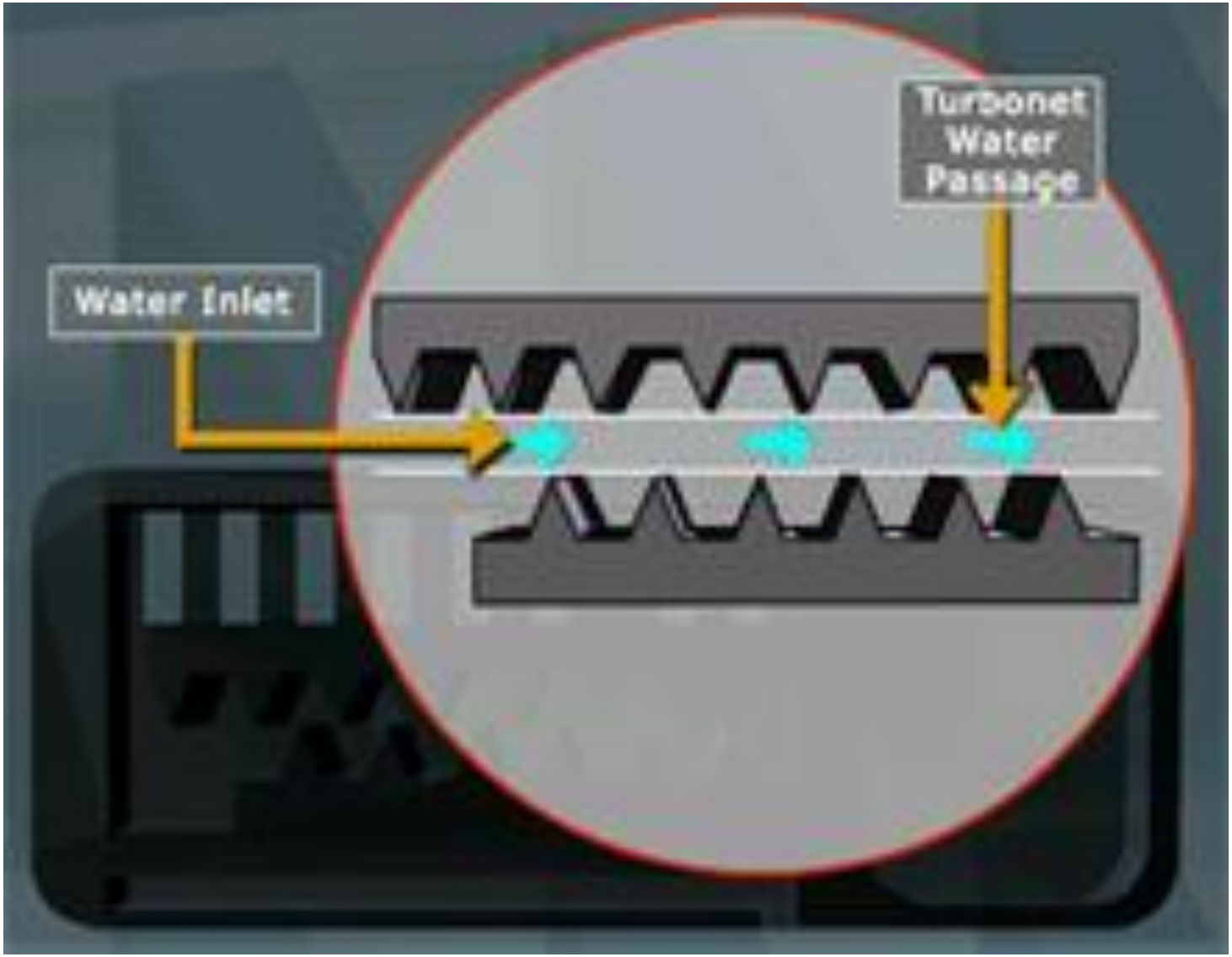


Simcha Blass

Netafim


A Culture of
Innovation
Our skilled, dedicated R&D staff actively cooperates with renowned international agricultural research institutions to ensure that Netafim customers enjoy access to cutting-edge technology and agronomic innovation. In 1965, we invented drip irrigation as a uniquely effective way of delivering water and fertilizers to crops. This innovation followed by many others, led to drip irrigation gaining worldwide acceptance even in regions with marginal and harsh water.
Increased use of our irrigation solutions worldwide continues to spur the consistent development of products that not only help growers to overcome problems, but open new opportunities for expansion and growth.
With many new products in the pipeline, the rich stream of ideas continues to flow.
2003 - DripNet
Compact Compens
Dripperline
2000 - Uniram
Integral Compensated
C.N.L Dripperline
1996 - PCJ Online
Compensated
Junior Dripper
1989-1994: Integral
Regular Dripperlines
(Typhoon, Tiran,
Streamline)
1983 - Ram
Integral Compensated
Dripperline
1977 - PC
Pressure Compensated
Online Dripper
1975 - Button Regular
Online Dripper
1970 - Inline
Turbulent Dripper
1967 - Inline
Laminar Dripper

Netafim



Issues

- Labour
- Energy
- Water
- Nutrient

Input Cost

Market Specifications

R & D Process

Labour

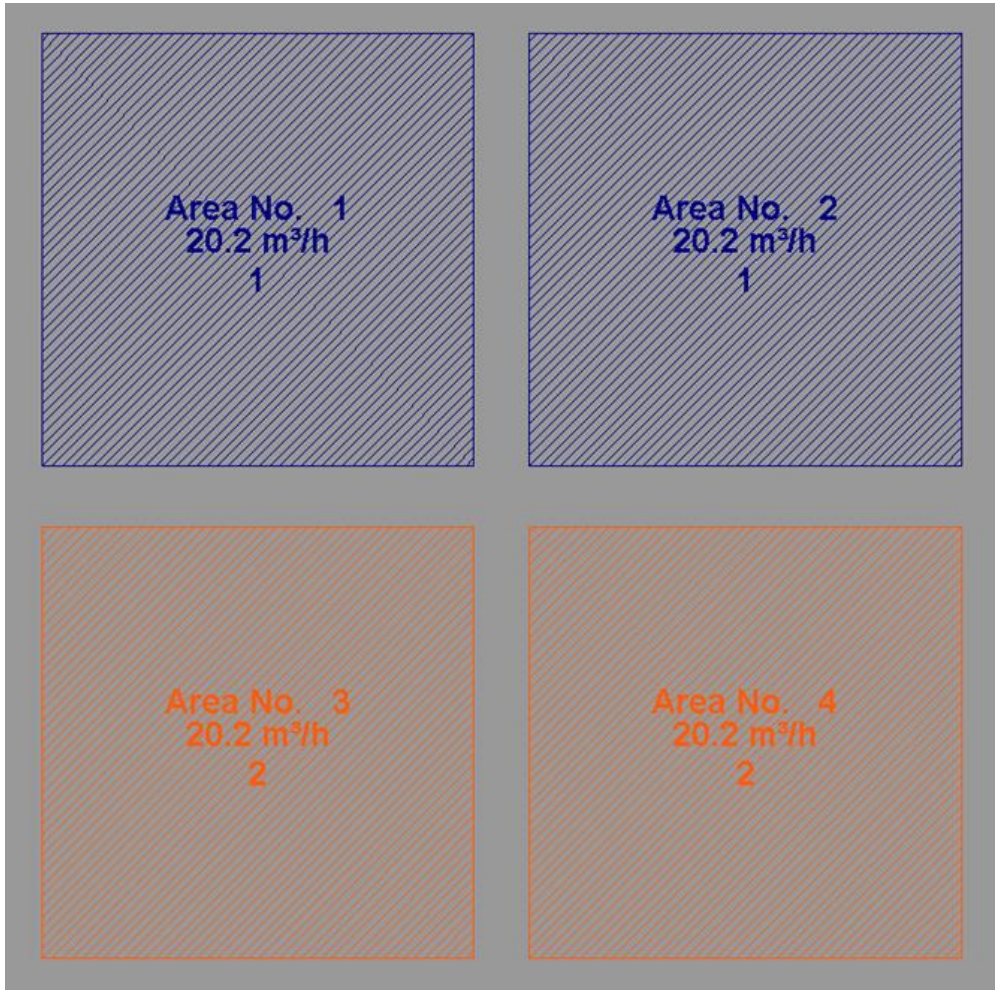
Labour - FlatNet

Labour - FlatNet

Water

Water – Low Flow Emitters

Energy – System Design



Energy – LEAF Filter

Nutrient – EC & pH control

Nutrient – EC & pH control

Market Specifications

Market Specifications

THANK YOU

NETAFIM™
GROW MORE WITH LESS

Harvesting

AUSVEG

JOHN DEERE

Having a bad day…..

Harvesting

AUSVEG

JOHN DEERE

RICE

JOHN DEERE

CORN

COTTON

JOHN DEERE

SUGAR CANE

Top 10 Sugar Cane Producers — 2010	
Country	***Production (Tons)***
Brazil	672,157,000
India	285,029,000
People's Republic of China	116,251,272
Thailand	66,816,400
Pakistan	50,045,400
Mexico	49,492,700
Colombia	38,500,000
Philippines	32,500,000
Australia	30,284,000
Argentina	29,000,000
World	**1,743,068,525**

SPECIALTY CROPS

- Harmful chemicals
- Weed control
- Workforce efficiency
- Reduce harvest labour
- Newest methods universities Ag Departments and associations
- Skilled labour
- Labour for repetitive tasks
- Labour ergonomics
- Reduce number of passes
- Irrigation solutions

SPECIALTY CROPS

- Production cost
  - Margins are lower than we understand
  - Much more equipment and input intensive than other crops (20+ passes)
  - Face growing competition from low (labor) cost countries
- Quality, quantity and market timing
  - Differentiation via branding, new varieties
  - Even processed foods need to be top quality
  - Production spread out to provide consistent supply
- Labor management
  - Harvesting, pruning are still manual tasks and make up 40% of costs
  - OH&S is always an issue
  - Available low skill workforce
  - Manual labor is typically outsourced
- Resource management
  - Competition from urban encroachment for land and water
  - Cost and availability determine rotations

VEGETABLE INDUSTRY FINDINGS

- Fragmented, highly customised industry
  - Large variety in practices between crops, regions and even farms – often requiring them to adapt equipment to their unique needs
  - No dominant brand / player in any category No supplier offers a complete product offering
  - Possibly tool carrier-type equipment encompassing ground preparation, planting fertilizer and pesticide application and harvesting.
- Vertical integration of large / Outsourcing by small players
  - In harvesting, for example, large downstream operations and contractors make up 50% of equipment ownership and operation
  - Fresh produce industry is dominated by grower/packer
  - We believe many larger producers will form own "outsourcing" companies for spray, transport, harvest, etc. and outsource to contract growers
- Highly regulated
  - Chemical compliance and drift (air quality) issues
  - Food safety and sustainability driven by consumer pressures

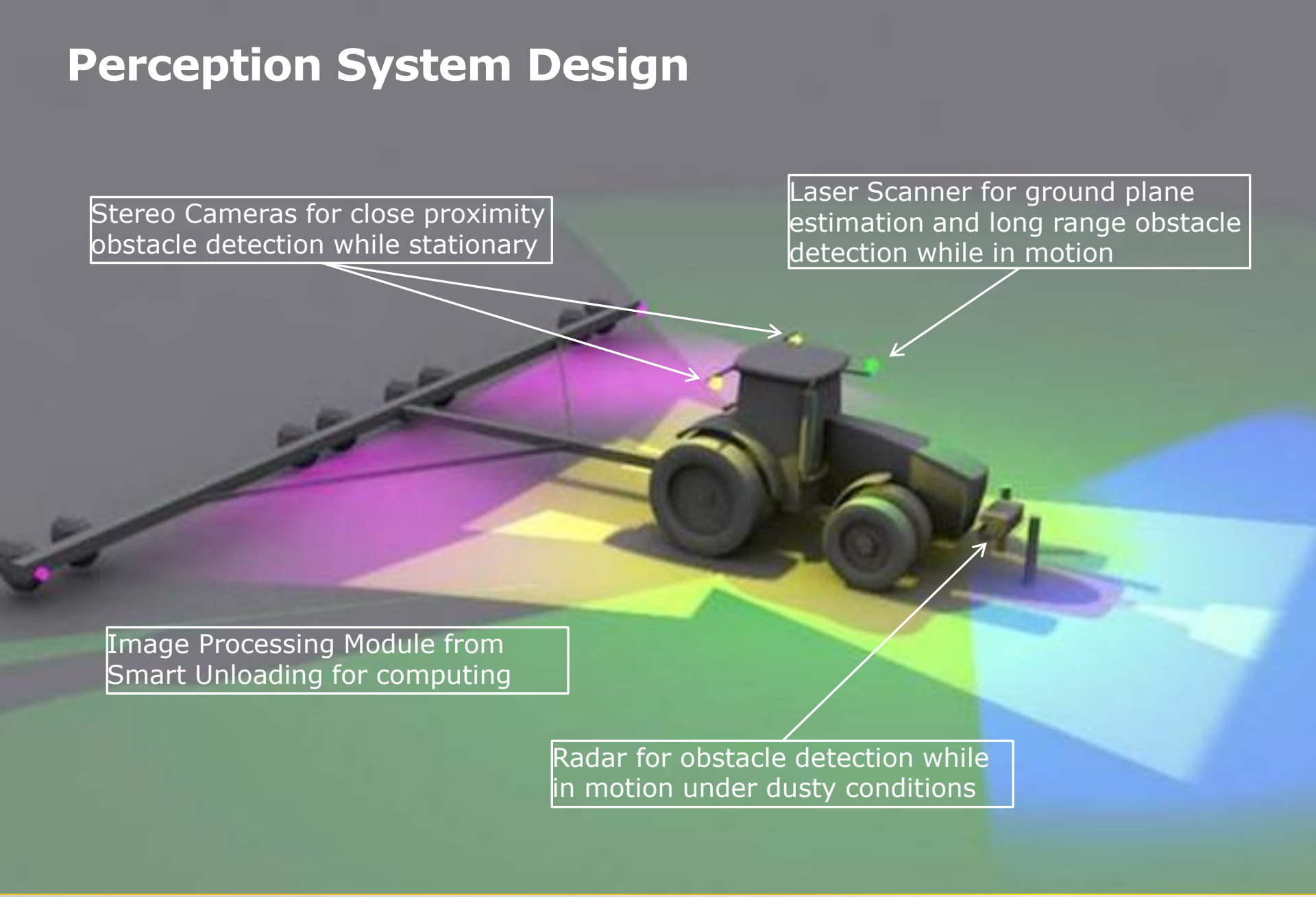
JOHN DEERE OPPORTUNITIES

- Tractors: Expand our tractor portfolio to support autonomy, precision applications on products suitable for this industry
- Water: Remote monitoring and control
- Robotics: Expand in-field robotics, vision and sensor research to reduce labor skill and effort required
- Enable more effective planting, spraying, cultivation tasks
  Plant, tree and vine genetics
- Flexible multi-function (alternative fuel /power) units
- No-drift spray solutions pest and disease prevention technology

DEERE DIRECTION

- Water: John Deere Water expansion focus on VR irrigation
- Technologies: Extend FarmSight and precision farming product portfolio outside our traditional markets
  - Extend precision technology to tractors under 100 horsepower
  - Support variable rate specialty applications
- Improve ease-of-use with tractor technology functions
- Tractor-Implement solutions (Work with implement manufacturer's to the next generation of ISO BUS technology

Perception System Design



ROBOTICS

JOHN DEERE

AUTONOMOUS

Video

Questions

JOHN DEERE

JOHN DEERE

Harvesting Technology

AusVeg 2012

JOHN DEERE

APPENDIX 5
Speaker Review

Future Technologies Seminar Speaker Review

(Based on results of survey provided to all in attendance)

- **Genetic Modification**

Speaker: Dr Roger Hellens (Plant & Food Research NZ) = **8.6**

- **Nanotechnology**

Speaker: Dr Terry Turney (Monash University) = **8.3**

- **Processing Innovations**

Speaker: Dr Mala Gamage (CSIRO) = **7.3**

- **Microwave Technology**

Speaker: Dr Graham Brodie (University of Melbourne) = **8.3**

- **Irrigation Innovations**

Speaker: Mr Sam Birrell (Netafim Agronomist) = **7.1**

- **Crop Harvesting Innovations**

Speaker: Mr Kevin Platz (John Deere) = **8.0**

- **Robotics in Agriculture**

Speaker: Associate Professor Salah Sukkarieh (University of Sydney) = **9.5**