Brassica think tank

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ARRIS Pty Ltd

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This final report details the outcomes of a one-day workshop held in Adelaide, 7 August 2008, where Brassica vegetable growers, researchers, vegetable IDOs, processors and consultants determined the priorities for future investment of national vegetable levy funds in Brassica vegetable research and development (R&D) projects.

We appreciate the time given by growers away from their farms to contribute to the workshop. We also acknowledge State Departments of Agriculture and other employers for granting their staff the time to attend the workshop to contribute their knowledge and expertise.

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MEDIA SUMMARY

The Brassica Think Tank was held in Adelaide in August, 2008 and was funded by the National Vegetable Levy and Australian Government through HAL. Comprised of 10 growers (including 2 grower/processors), 9 researchers from State Departments of Primary Industries and CSIRO, 3 Vegetable Industry Development Officers and 5 other industry representatives the group discussed current HAL projects and issues facing the Australian Brassica vegetable industry. The Think Tank presented an opportunity to improve rapport, dialogue and working relationships between growers and researchers and other industry people.

Information was presented by researchers on current and recently completed HAL projects being undertaken on Brassica vegetables. Attendees discussed issues facing the Australian Brassica vegetable industry and determined the priorities for future research and development investment. These recommendations for future research and development investment in Brassica vegetables will be communicated to HAL, AUSVEG and the Vegetable Production Advisory Group and Vegetable Industry Advisory Committee.

The following were considered to be the most important issues that need to be addressed to ensure the sustainability of the Australian Brassica vegetable industry:

1. Diamondback Moth management
2. Soil and its role in Integrated Crop Management
3. Communication and extension of Brassica vegetable research
4. Fertiliser and nutrient management
5. Predictive modelling (white blister) and surveillance of pests and diseases
6. Revegetation by design
7. Integrated Pest Management consultant training
8. Chemical use
9. Integrated Pest Management/Integrated Crop Management awareness, adoption and extension
10. Other IPM issues (control of secondary pests and maintaining research expertise)

Delegates recommended that a Brassica Think Tank and report on current Brassica vegetable research be held every two years. It was also recommended that Think Tanks be held for other vegetable groups.

RECOMMENDATIONS FOR FUTURE R&D INVESTMENT

The issues identified for the Australian Brassica vegetable industry were discussed and prioritised by Think Tank delegates. It is recommended that these priorities be used by HAL and the Vegetable Advisory Groups and Vegetable Industry Advisory Committee to determine R&D investment in Brassica vegetables.

Some of the priorities for R&D investment are Brassica vegetable specific and others are general to all vegetables. It is likely that these general priorities would be considered a priority for R&D investment by the whole vegetable industry.

The issues that were considered of highest priority for R&D investment (refer to Table 2 in the 'Identified Issues for the Brassica industry' section) were discussed in more detail than is given in Table 2 by delegates and considerations for future projects in these areas are given below.

In addition to the priorities discussed here delegates asked that it be strongly recommended that a Brassica Think Tank be held every 2 years to plan Brassica R&D investment, discuss current issues and to ensure grower input in setting Brassica R&D priorities. It was also strongly recommended that a Brassica research forum to allow communication with, and feedback from, growers every 18 months to 2 years. It was suggested that this activity be held in conjunction with the AUSVEG conference.

1. Diamondback Moth Management (DBM)

Continued research into DBM management was considered a very high priority and was by far considered the highest priority for R&D investment by Brassica vegetable growers. The current research program should be continued and the extension and communication component of the program should be reinstated. This has been an important and well-received component of the program in the past and is necessary for adoption of DBM research outcomes.

2. Soil and its role in Integrated Crop Management (ICM)

Research into soil and its role in ICM was considered a high priority. A project in this area should address:

- Rotation crops
    - how they can be used for disease control?
    - biofumigants
    - what rotation crops clean up weeds and diseases for Brassicas?
    - what effect do rotation crops have on beneficial populations and pest populations?
    - what rotation crops are IPM compatible?
- Soil amendment information
    - what do they do?
    - do they work?
    - on-farm trials required
- What are the consequences for Brassica crop management of changing to a no-till/reduced till system?

3. Communication and extension

Communication and extension of the outcomes of Brassica R&D projects was considered a high priority. Suggestions included a national roadshow, taking experts to the key Brassica vegetable growing regions and on-farm demonstrations. These roadshows would also present an opportunity to identify key issues facing the different regions and could feed into

future Brassica vegetable R&D priority setting exercises. The role of Vegetable Industry Development Officers disseminating information to growers was also highlighted, as was the need for a good archive of project information on the web.

4. Fertiliser and nutrition management

Increasing the knowledge of fertiliser and nutrition management was considered a priority. A project in this area should address:

- Increasing the skills and knowledge of growers and their advisors about soil nutrient management (e.g. workshops)
- Tools to help identify nutrient disorders
- Better application methods
- Alternatives to fertilisers
- Do we really know and understand the nutrient needs of Brassica crops?
- Scoping study to determine what we do and do not know about fertiliser usage and management in Brassica crops
- Fertiliser input versus yield trials
- Interaction between soil tests/fertiliser interactions/nutrient availability studies.

5. Predictive modelling and surveillance of pests and diseases

Continued research into predictive modelling of white blister was considered a priority. Additionally, pest and disease surveillance should be funded so that industry can be prepared for any future problems that may occur. A study of pest and disease incursions existing overseas should be conducted so that Australian growers are aware of the potential threats to their industry.

6. Revegetation by design

It was considered a priority that the revegetation by design research that is currently underway in SA and Queensland be continued as it is a vital component of Integrated Pest Management (IPM). It was suggested that a communication component be added to the current project so as to facilitate grower groups and to link with different Departments and Catchment Management Authorities/Natural Resource Management Boards. Future projects in this area should include:

- A national approach to revegetation by design
- A working group with grower representatives and research providers from each State
- National communication.

7. Integrated Pest Management (IPM) consultant training

How to get more IPM consultants on-the-ground and to increase the IPM skills of growers was considered a priority. A project in this area should include:

- Development of a training package to educate consultants and growers about IPM in Brassica vegetables
- Subsidise growers and consultants to attend training in IPM for Brassica vegetables in small collaborative groups
- Training and employing IPM consultants
- Building vegetable industry IPM knowledge – harvesting the knowledge that some of the IPM consultants and growers that have been involved in IPM have and making it available to the industry.

WORKSHOP DELEGATE LIST

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WORKSHOP AGENDA, AIMS, OUTPUTS AND METHOD

Agenda

A summary of the workshop agenda is presented below and the agenda as sent to workshop attendees prior to the workshop is given in Appendix 1.

1. Welcome and aims of the day

2. Outline of past and current Brassica vegetable R&D

3. Research summaries outlining key outcomes and gaps in knowledge
   Greg Baker: Summary of Brassica IPM in the last 10 yrs
   Cate Paull: DBM
   Paul Horne: IPM
   Barbara Hall: Stem canker
   Liz Minchinton: White blister
   Len Tesoriero: Asian vegetables pest & diseases
   Jenny Ekman: Asian vegetable names & postharvest/export
   Rachel Lancaster: mechanisation/harvesting
   Nancy Schellhorn: revegetation
   David Carey: Brassica Integrated Crop Management Toolkit CD

4. Break-out sessions in small groups to identify key Brassica R&D issues

5. Discussion of identified issues and grouping

6. Voting to identify the priority areas for future R&D

7. Discussion on the top R&D priorities

Aims

The aims of the Brassica Think Tank were:

1. Gain an understanding of levy funded Brassica vegetable Research & Development (R&D) projects – past and present
2. Bring together growers and a diverse group of stakeholders who can best identify issues throughout the value chain
3. Identify strategic issues, needs and drivers for future Brassica vegetable R&D in Australia
4. Develop project definitions for R&D priorities.

Proposed Outputs

1. Strategic research recommendations for the Australian Brassica industry
2. Communication of outcomes of Brassica Think Tank through Vegetables Australia, IDO newsletters and Brassica IPM newsletter
3. HAL and Vegetable Advisory Groups to be advised of outcomes of Think Tank so as to provide a guide for R&D investment for the Brassica industry.

Method

Prior to the workshop the Brassica industry was invited to submit their issues for consideration at the Think Tank. Information about the Think Tank was provided to each

Vegetable Industry Development Officer. Both the NSW and SA Vegetable Industry Development Officers included information about the Think Tank and a feedback sheet in a Brassica mailout.

Growers who were invited to the Think Tank, but were unable to attend were interviewed by phone.

Each delegate was provided with the agenda and a list of HAL Brassica vegetable projects (current and recently completed) prior to the Think Tank.

At the Think Tank researchers were asked to give a 5 – 10 minute presentation outlining their current or recently completed Brassica vegetable project/s, including key outcomes and identified gaps in knowledge. These presentations enabled delegates to gain an understanding of the type of projects that have been funded in the past or are currently funded and what the outcomes of these projects are, or are expected to be. Highlighting knowledge gaps also allowed delegates to begin considering what might be identified as issues and R&D priorities for the Brassica vegetable industry in the future.

Following project presentations delegates were divided into 4 groups for an hour to discuss key Brassica vegetable industry issues. The aim was to have a mix of researchers, growers and other industry representatives in each group and to not have a group with everyone from the same State. The authors of this report, both Vegetable Industry Development Officers, as facilitators of the Think Tank did not join a specific group. The groups were as follows:

Group 1 (Yellow)
Len Tesoriero
Nancy Schellhorn
John Jeffs
Roger Orr
Jeff McSpedden
Nick Thomas

Group 2 (Green)
Greg Baker
David Carey
Rachel Lancaster
John Cranwell
Joseph Fragapane
Kevin Temple

Group 3 (Orange)
Liz Mincinton
Paul Horne
Domenic Cavallaro
Jenny Ekman
Scott Samwell
Nathan Parker
Nathan Clackson

Group 4 (Pink)
Bob Holloway
Cate Paull
Barbara Hall
Steve Newman
Paul Gazzola
Michael Savvas

To assist the groups they were asked to consider:

- On-farm issues
- Issues/needs identified from current/completed research projects
- Postharvest
- Processing
- Pests
- Diseases
- Soil health
- Integrated Crop Management
- Consumers
- Other Brassica vegetable industry issues.

The groups were asked to put each identified issue on a separate large sticky note (different coloured notes used for each group). Following group discussions, all of the issues were placed on one wall for delegates to discuss as a whole. Delegates were asked to group like issues.

Following grouping of issues delegates were asked to vote for the issues they thought were of the highest priority; that is those issues they would most like to see future R&D investment in.

Once the priorities for R&D investment were decided some discussion was had by the delegates on what would be included in a project to address those priorities. During this discussion delegates were asked to consider:

- What is the problem?
- How should it be investigated?
- What outcomes are we seeking?
- How should it be delivered?
- Who would investigate it and deliver the outcomes?
- How will it be implemented on-farm?

SUMMARY OF BRASSICA RESEARCH PRESENTATIONS

Below are the key points from presentations made by researchers at the workshop to give delegates a summary of current and recently completed HAL Brassica vegetable projects. Project summaries, supplied by some researchers prior to the workshop, are given in Appendix 2. Of particular importance to the Think Tank were the research gaps identified by the presenters. These gaps are summarised in Table 1 at the end of this section.

1. Australian Brassica Vegetable Industry Pest Management (a summary of HAL funded research from the last ten years)

Presented by Dr Greg Baker, SARDI

- Since 1997 there has been a substantial increase in the awareness and adoption of sound IPM (integrated pest management) and IRM (integrated resistance management) principles and practices by Australian Brassica vegetable growers – the knowledge base and the range and quality of tools available to growers has been considerably expanded.
- Brassica IPM (circa 1997): almost no crop monitoring except in Queensland; calendar spraying was the norm; increasing levels of OP and SP resistance with numerous reports of spray failures.
- Brassica IPM (circa 2008, cup ½ full version): industry awareness of the threat of insecticide resistance raised and 30 – 40% of growers complying with the AIRAC IRM strategy; no spray failure reports with new chemistries; industry awareness and interest in spray thresholds and crop scouting raised (the practice currently limited but increasing); an increasing minority of growers are now achieving quality harvests with substantially fewer and softer spray applications; grower awareness and interest in the role of natural enemies has been stimulated.
- National Diamondback Moth (DBM) Project 1997 – 2007 had team members from all states with key achievements being: "Two-window" IRM strategy development and promotion; national DBM resistance screening program; fostering of crop scouting; biology for IRM/IPM benefits (local movement of DBM and its parasitoids); natural enemy enhancement and management; integrated multiple-pest management in Qld; many extension products and activities (spray application roadshow, Brassica IPM Handbook, Brassica IPM Newsletter, insecticide toxicity chart, IRM "2-window" strategy flyers, translation of all material into Chinese, DBM website, chemical reseller DVD "The Reality of Resistance" and IPM field demonstration sessions with Paul Horne and Jessica Page).
- Brassica IPM (circa 2008, cup ½ empty version): majority of growers do not adhere to the '2-window' IRM strategy; despite strong advocacy for softer chemistry, 30% of Brassica insecticide sprays are still SP's and OP's; limited availability of IPM-competent consultants; field control failures with Proclaim, Success and Avatar may be imminent.
- Where to from here: growers that practice IPM are strong advocates for the approach; many growers want to move towards IPM; adoption behaviour is generally consistent with one's self-interest (profitability with economic case studies possibly assisting); main barrier to IPM adoption appears to be lack of confidence and access to experienced practitioners; a part solution could be crop scout/consultant education; recent survey identified spray techniques as most sought after topic for more information/skill development by Brassica growers; spray application roadshow; developing sustainable solutions for Integrated Brassica Crop Management (VG07030); identification of immune suppressors of DBM (VG08048); mechanisms and management of resistance to new insecticides and Bt in Australian DBM.

2. National Diamondback Moth (DBM) Project (VG07030)

Presented by Dr Cate Paull, SARDI

- Resistance Management: Current – Continue monitoring regional populations of DBM and investigate parasitoid (wasp) venom; Outcomes – Isolate mechanisms within DBM that are responsible for resistance and development of novel biological control compounds using parasitoid venom proteins; Future Research Needs – Continue resistance screening and begin work on novel biologicals for managing DBM and trial new and more effective mechanical spray technology.
- Integrated Pest Management: Outputs and Outcomes – Development of IPM tools; Future Research Needs – Activities and structured training to increase adoption and implementation of IPM and continue integrating new findings and research which contribute to advancing IPM of DBM.
- Definition of IPM: Integration of cultural, chemical and biological tools to reduce the reliance on a single tactic.
- IPM Future Research Needs: DBM early season populations (movement forecasting, influence on resistance); Addressing lag phase between pest and natural enemies, especially parasitoids (cultivation of natural enemies on site – natural enemy nurseries); Could native vegetation contribute to IPM in brassica production systems (preliminary work investigated which species might be used was completed in last project); Other pests in brassicas (secondary pests, contamination).
- Integrated Crop Management: Current – Quantify the effects soil amendments have on breakdown of harvested brassica crop residue, reservoir of soil and plant borne pathogens, invertebrates ground predators (detritivores) and DNA probes developed for a range of brassica pests are being used to investigate functional role of predators; Outcomes – Begin identifying and quantifying multiple benefits of soil amendments; Future Research Needs – Cost benefit analysis total inputs versus outputs, precision inputs for soil/plant health for example water use efficiency.
- Integrated Crop Management (continued): Current – Early season pest control in Queensland brassica crops; Outcomes – Designing a management strategy for a range of early season pests that is least disruptive to IPM programs later in the season; Future Research Needs – Research, adoption and training.
- Summary of Research Needs: Resistance Management – New generation biologicals for DBM and trial new spray technology; Integrated Pest Management – Increasing adoption, early season DBM populations and impact on resistance and enhancing natural enemies in nurseries and native vegetation; Integrated Crop Management – Incorporating plant/soil nutrient metrics and cost benefit analysis of outputs and inputs.

3. Demonstration of Integrated Pest Management (IPM) in Brassica Crops (VG05007)

Presented by Dr Paul Horne, IPM Technologies Pty Ltd

- Current conventional practice for pest management includes the use of insecticides/miticides, selecting a pesticide to manage the pest and spraying a label rate.
- Developing integrated control strategies should be developed as control measures targeted at one pest can interfere with the control of other pests in the same crop; the cheapest option to control one pest can easily end up causing greater losses and costs by inducing other pests.
- On-farm demonstrations have successfully been held in Tasmania, Western Australia and Victoria.

4. Managing Brassica Stem Canker (VG06018)

Presented by Barbara Hall, SARDI

- History: In spring 2000 growers submitted cauliflower samples with stem rotting for disease diagnosis and some reports were of 80% loss with collapsed plants; VG05015 funded for July 2005 to July 2006 to carry out a scoping study to determine the soilborne diseases affecting Brassica crops and disease was found to be complex with up to 100% loss with cauliflower the worst affected; VG06018 funded from July 2006 to July 2009.
- Project work includes pathogenicity studies, plant infection trials, debris burial trials, variety trials and fungicide trials.
- Future work includes cultivar susceptibility to *Leptosphaeria*; further investigations into when *Leptosphaeria* infection occurs and symptoms are expressed; evaluation of biologicals and fungicides to manage *Leptosphaeria*; field trials evaluating management strategies to control both *Rhizoctonia* and *Leptosphaeria*; investigating carry over of fungi in soil, other crops and weeds.
- Gaps in research include fungicide application techniques; rotations; compost and soil amendments; nutrient interactions; interactions with soil biota and minor pathogens; weather/water.

5. Benchmarking Predictive Models, Irrigation and Nutrients for Management of Downy & Powdery Mildews and White Blister (VG07070)

Presented by Dr Liz Minchinton, DPI Victoria

- White blister research has focussed on validating the new white blister model (Brassica^{spot} II); developing an aerial spore test kit; potential of Vapour Pressure Deficit; review of weather station technology; effect of nutrients on disease; effect of irrigation timing on disease; economics and benchmarking.
- Brassica^{spot} II model from the UK; UK is writing 'drivers' so as to convert Australian weather data rapidly into the model; trial with tolerant and susceptible cultivars on broccoli, chinese cabbage and cauliflower with the use of standard chemicals and softer chemistry; benchmarking the economics and efficacy of model.
- Validation of aerial spore trap with field trials; use in conjunction with model and has potential for other diseases with airborne spores.
- Trials at Werribee Expo site looking at irrigation timing and incidence of white blister on radish and downy mildew on spring onions.
- Trials planned to determine if nutrient load is increasing the susceptibility of plants to diseases (white blister on brassicas).
- Project team consists of members from DPI Victoria, Warwick HRI (UK), Queensland DPI&F, The University of Queensland, Peracto and SARDI.

6. Integrated Management Strategies for Diseases and Pests of Asian Vegetables (VG04032)

Presented by Len Tesoriero, NSW DPI

- Key objectives of project include improving product quality through improved management of pests and diseases; identifying key pests and diseases, their distribution and IPM-compatible chemicals; developing improved management strategies and demonstrating their effectiveness on-farm; producing/adapting resources for training.
- Surveys/diagnosis/remedy: on-farm and participatory research focus.

- Regions surveyed include Sydney, Werribee, Brisbane, Darwin and Launceston.
- Linkages to other projects and resources include diagnostic facilities, records and photographic resources; previously published information from HAL projects; AusAid/ACIAR projects in Vietnam and Cambodia; NSW DPI bilingual officers (Vietnamese, Arabic, Chinese and Cambodian) and food safety initiative (pesticide residue monitoring).
- Important diseases include root rots (*Pythium* spp., *Phytophthora* spp., *Rhizoctonia* spp. and *Fusarium* spp. – poor response to microbial biocontrols but some control with fungicide seed dressings); club root (some response with Bion® seed dressing, move to hydroponics); turnip mosaic virus, white leaf spot.
- Extension outputs were IPM card game; pest and disease fact sheets in English, Vietnamese and Chinese; disease recognition posters.
- Knowledge gaps: Thrips, Rutherglen bugs and striped flea beetles are difficult to control at present; Club root and downy mildew have become more prevalent in Sydney Basin; Turnip mosaic virus and white leaf spot of leafy brassicas require further study.
- Key messages: key diseases and pests have been identified; monitoring and action threshold strategies have been developed and have been successful to-date – but it will take time to validate them and will require further support; some pests and diseases will require further R&D to apply IPM successfully.
- Project team consists of members from NSW DPI and DPI Victoria and is jointly funded by the Rural Industries Research and Development Corporation (DAN-233J).

7. Asian Vegetables Market Access (VG04031) and Brassicas by Boat (VG06045)

Presented by Dr Jenny Ekman, NSW DPI

- Major issue for Asian vegetable growers is how they might be able to make a better profit. This can be done by reducing costs or increasing prices but best to market products better. It was recognised that a way to achieve this was to standardise the names for Asian vegetables so names in the shops matched the names in recipes. A list of standardised names was agreed to by the project steering committee and a poster produced – however not all shops are using the standardised names.
- Consumer survey showed that there is a strong interest in Asian vegetables yet they are only 2% of vegetable sales ($ value).
- Reasons consumers gave for not purchasing Asian vegetables were that they do not know how to cook them, the family might not like them, they do not know what they taste like (price was said to be less important in purchase decisions than these other factors).
- Asian vegetables are bought because the consumer is from an Asian background, or they are making a stir fry.
- Asian vegetables are predominantly bought by educated professionals, high income earners, city dwellers and families with no kids (or many kids); bought every 2 – 4 weeks with 16% saying they buy weekly.
- Survey showed that 75% of consumers make impulse purchases in-store and older shoppers from upper demographics the most likely to try Asian vegetables; “specials” can add interest; price is less important.
- Project “Evaluation of new shipping technology for Australian vegetables” trialled export of broccoli, cauliflower and lettuce to Dubai.
- It was shown that for this market broccoli was best transported in plastic lined cartons rather than ice and that modifying the atmosphere was not necessary; cauliflowers could also be shipped successfully in plastic; good temperature control is critical.
- Testing is underway for storage atmospheres, postharvest dips and other treatments to allow transport to Europe.

8. Improving Uniformity of Crop Maturity (VG02051, VG04008 & VG06013)

Presented by Rachel Lancaster, Department of Agriculture & Food WA

- Three projects: VG02051 Agronomic packages for reduced pass harvesting of export cauliflower; VG04008 Export cauliflower – Alternative planting configurations; VG06013 Use of plant growth regulators for reduced pass harvesting of cauliflower and broccoli.
- VG02051: One pass harvesting is possible for cauliflower and broccoli; tested on loam soils; focus on plant nutrition and irrigation management; comparable yield to selective harvest; project completed February 2008.
- VG04008: Examined within row density and row configuration; plant density can be increased on loam and sandy soils; no major impact on improving crop uniformity but did improve yield for some crop densities; examined different covering options that can be applied mechanically; project completed February 2008.
- VG06013: Examines role of the PGR's, gibberellic acid (GA) and ethephon on promoting initiation of reproductive phase; aim of PGR's is to promote even crop initiation and improve uniformity of crop maturity; GA looks promising for use in broccoli to promote crop reproductive initiation; current project to March 2010.

9. Phase II: Native Vegetation to Enhance Biodiversity, Beneficial Insects and Pest Control (VG06024)

Presented by Dr Nancy Shellhorn, CSIRO

- Revegetation by Design research questions: Is there value in native remnant vegetation for pest control, Qld – do insects move from native vegetation to crops; what are the risks; community perception and behaviour towards native vegetation as part of IPM.
- Is there value (bi-directional Malaise traps in 4 habitats, 2 landscapes, 1 year): edge habitat between riparian vegetation and crops important; net immigration of beneficials from all remnant vegetation to crops, particularly riparian vegetation, and landscapes with high % remnant; different types of native vegetation important.
- What are the risks (110 vegetable pests, 48 crops, cross referenced 110 pests with 1271 host records including 453 native plants): no generalisation about what makes a pest of vegetable crops, e.g. exotic versus native, taxonomic group, diet breadth; 20 pests perceived too difficult to control (differ between SA and Qld); 37 plant families are low risk for vegetable pest management.
- Community perception (survey of growers in the Lockyer Valley, Qld): majority interested in concept; most have average to high regard for native vegetation, e.g. erosion prevention and wind break, draw back water and room; to move forward with revegetation by design growers need demonstration and guidelines.
- Joint project between CSIRO and Queensland Department of Primary Industries & Fisheries.

10. Brassica Integrated Crop Management (ICM) Toolkit CD (VG07030) and Sucking Pest Scoping Study in Vegetables (VG06094)

Presented by David Carey, Queensland Department of Primary Industries & Fisheries

- The Brassica ICM CD is a multimedia toolkit containing information relevant to anyone involved in Brassica vegetable production in Australia; an outcome of the project "Developing Sustainable Solutions for Integrated Brassica Crop Management."

- The CD contains 355 fact sheets, management tools and an interactive diagnostic tool.
- The CD has been distributed to Australian Brassica growers and growers will be surveyed to evaluate the CD and assist them where necessary.
- The project team involved members from Qld DPI&F, The University of Queensland and SARDI.
- Sucking pest scoping study in vegetables (including Brassicas) final report recently completed; reviewed the major sucking pests in vegetables (aphids, thrips, minor "bug" species, and silverleaf whitefly).
- Aphids and thrips spread virus (it is interesting that current population detection and monitoring techniques are not more advanced, this is not an oversight by the industry to-date, but is probably more related to the advancement of soft option pesticides for other pests over the past 5 to 10 years).
- The time has come to move forward and develop effective, easily managed tools to allow early detection of the arrival of aphids, thrips and minor bugs in commercial vegetable crops.
- Effective monitoring needs to include the identification of moving populations not just those settled in the crop and development of forecast models based on local weather data and insect biology to flag possible pest arrival periods.
- Education and assistance to include farm demonstrations, promotion to industry the benefits of "soft option products", determination of the $ value of having beneficials in crop and develop sucking pest thresholds.
- Soft option products: link to current minor use and biocontrol projects and overseas data, expose and promote new specific soft products to industry for sucking pest control; ban minor use applications for older broad spectrum chemistry where new soft option products exist.
- Rutherglen bug as a contaminant pest, especially in mechanical, multiple-harvest leafy crops: increase our knowledge about this emerging pest as it may provide key to future control.
- Emerging technology: investigate radio waves, ultrasonics and others as means of moving contaminant insect out of the harvest zone without using chemicals; this relies directly on good knowledge of the target pests' biology.
- Integrate all disciplines: future work to be multi-disciplined and multi-crop based rather than just single problem focussed; combine system knowledge gained from revegetation by design work that documents the value of native vegetation and waterways as sources of beneficial insects with good farm hygiene, effective monitoring and sucking pest specific soft options to build an effective, sustainable IPM approach to Brassica production.

Table 1. Identified research gaps from current and recently completed HAL Brassica vegetable projects.

Research Area	Knowledge Gap
IPM adoption	• Use growers who practice IPM as advocates • Improve growers confidence to adopt IPM and access to experienced practitioners • Crop scout/consultant education • Spray technique information and skill development (roadshow) • Develop sustainable solutions for Integrated Brassica Crop Management (VG07030) • Identification of immune suppressors of DBM (VG08048) • Mechanisms and management of resistance to new insecticides and Bt in Australian DBM
DBM resistance management	• Continuity of resistance screening • New generation biologicals for DBM management • New spray technology trials
DBM IPM	• Activities and structured training to increase adoption and implementation of IPM • DBM early season populations (movement forecasting, influence on resistance) • Enhancing natural enemies using nurseries and native vegetation
DBM ICM	• Cost benefit analysis of inputs versus outputs • Precision inputs for soil/plant health (e.g. WUE) • Research, adoption and training
IPM	• Development of integrated control strategies rather than control strategies targeted at 1 pest (may induce other pests) • Continued on-farm demonstrations
Brassica stem canker	• Fungicide application techniques • Rotations • Compost and soil amendments • Nutrient interactions • Interactions with soil biota and minor pathogens • Weather/water
Pest and disease management in Asian leafy Brassicas	• Validation of monitoring and action threshold strategies • Some pests and diseases need more research if IPM is to be successfully adopted (Thrips, Rutherglen bugs, Striped flea beetles, Turnip mosaic virus, White leaf spot)
Revegetation by design	• Demonstrations • Development of guidelines for growers
Management of sucking pests	• Development of effective, easily managed tools to allow early detection of the arrival of aphids, thrips and minor bugs • Development of thresholds • Farm demonstrations • Promotion of “soft option products” • Determining $ value of using beneficials for control • Research into Rutherglen bug as a contaminant pest • Possible use of emerging technologies (e.g. radio waves, ultrasonics) as a control methods
ICM	• Future research to be multi-disciplined and multi-crop based rather than focussing on a single problem • Promote benefits of native vegetation and waterways as sources of beneficial insects and good farm hygiene

IDENTIFIED ISSUES FOR THE BRASSICA INDUSTRY

Issues as identified by each group and by individuals prior to the workshop are given in Appendix 3. Table 2 shows the issues, following grouping like issues by delegates. The grouped issues have been prioritised based on the votes given to each issue. Total votes given to each issue are shown as well as how many votes were given by growers and by other workshop delegates (researchers, consultants, other).

The 3 issues that were of the highest priority by all delegates were:

1. Diamondback Moth management
2. Soil and its role in ICM
3. Communication and extension.

The issues that were of the highest priority to growers were:

1. Diamondback Moth management
2. Fertilisers and nutrient management and Chemicals (equal 2nd)
3. Soil and its role in ICM, predictive modelling and surveillance of pests and diseases, IPM (consultant training) and IPM/ICM (awareness, adoption and extension) (Equal 4th).

Growers research and information needs were spread over a range of issues that can help improve their competitiveness.

Growers ranked highly 'IPM/ICM (awareness, adoption and extension)'. It could be argued that this should have been grouped with 'Communication and extension'. This suggests that this component of 'Communication and extension' be a strong focus on any future communication and extension projects.

Table 2. Identified issues and their rankings.

Issue*	**Grower votes**	**Other votes**	**Total votes**
Diamondback Moth management: • On-going program of DBM research and extension (need continuity of current program)	7	7	14
Soil and its role in ICM: • Do soil amendments work (need trials to get scientific data) • Soil health (crop rotations, compost, organic matter, cover crops, benefits to predators, $ associated with carbon offsets) • Soil management (tillage effects, soil amendments and rotations)	3	7	10

Communication and extension: • Roadshow to Brassica growing regions (presentations by experts and also an opportunity to identify key issues) • Extension using IDOs, workshops/demonstrations, follow up workshops with web and email (need good archive of projects on the web) • General communication between growers – we need to see ourselves as an industry, not individuals	1	8	9
Fertilisers and nutrient management: • Need to address increasing fertiliser costs • Fertiliser use workshops and communication covering better application techniques, alternatives, liquid versus granular, and knowing if fertiliser input levels are correct • What nutrients are used and what are wasted • On-farm modelling of nutrient use • Nutrient optimisation for brassicas • Mining existing nutrients and minimising fertiliser application • Salinity management	4	3	7
Predictive modelling and surveillance of pests and diseases: • White blister predictive modelling (on-going R&D program) • Pest & disease surveillance (foreseeing future problems so industry can be prepared) • Overseas problems (potential pest and diseases incursions)	3	4	7
IPM (revegetation by design): • National approach to revegetation by design • Cross-industry integration for pest and disease management (vegetables and broadacre) • Use of native vegetation and habitats for IPM	2	5	7
IPM (consultant training): • Need funding to get more IPM consultants established and give them training • Staff/consultant training in monitoring and pest and disease recognition	3	3	6

Chemicals: • Focus on bio-rational chemicals for minor use • Do not renew older chemistry minor use permits • Chemical registration (make obtaining minor use permits quicker and broaden crop list on each chemical label) • Indirect effects of herbicides and insecticides on diseases and pests (scoping study)	4	1	5
IPM/ICM (awareness, adoption and extension): • Where does industry go to get the information they need about ICM • Need more extension to explain ICM/IPDM • Communication on-farm about managing pests & diseases • Demonstration groups covering IPM, modelling and insect identification • Extension giving hints on spray optimisation of fungicides and insecticides • Understanding of IPM concepts • Take into account crops other than Brassicas on-farm when trying to get growers to adopt IPM	3	1	4
IPM (other): • Off-target pests and increase in “cosmetic” pests • Control of secondary pests • Long-term IPM/IDM R&D programs (maintain expertise in Australia)	2	0	2
Spray application techniques: • Increasing application and coverage of biologicals and chemicals • Efficacy • Off-target effects	0	2	2
Food safety: • Literature review and extension • Microbial contamination • Lifespan of microbes • Best and cost-effective way of removing microbes • Is there a safe level of E. coli in irrigation water	1	0	1
Climate change: • Impact of climate change on growing regions • Impact of climate change on pests and diseases • Communication to industry of current information • Low carbon production	0	1	1

Consumer: • Trends - what should be grown to meet consumer demands and where are we heading in the future • Food miles – is it an issue • Effect of Vital Vegetable project broccoli on broccoli market – will it increase the overall broccoli market or will it decrease demand for ordinary broccoli	0	1	1
Understanding the role of plant nutrition on product quality and shelf life	0	1	1
Transport & Packaging: • Affect of plastic return crates on product quality (new design has less venting) • Reducing costs in transport & packaging (what are the possibilities, e.g. better packing, use of rail) • Ownership of crates (when does it pass over between grower and supermarket)	0	0	0
Water: • Salinity management • What is used and what is wasted (on-farm modelling)	0	0	0
Role of GM in Brassica vegetables: • Pesticide reduction • Opportunity to control input costs (Group comment was that the use of GM in vegetables would probably be the decision of seed companies)	0	0	0
Economics • Cost benefits • Desktop study to identify key input costs & improved efficiency strategies	0	0	0

*Abbreviations:

- DBM – Diamondback Moth
- IDO – Industry Development Officer
- IPM – Integrated Pest Management
- ICM – Integrated Crop Management
- IDM – Integrated Disease Management
- IPDM – Integrated Pest and Disease Management
- GM – Genetically Modified

APPENDIX 1: MEETING AGENDA

Brassica Think Tank Agenda

Thursday 7th August, 2008
8.45 am – 4.00 pm
SARDI Plant Research Centre (Meeting Rooms on Ground Level)
Hartley Grove, Waite Institute, University of Adelaide

8.45 am	Arrive
9.00 am	Welcome and aims of the day
9.15 am	Outline of past and current Brassica R&D
9.30 am	Research summaries – key outcomes and gaps (7 min each) Greg Baker: Summary of Brassica IPM in the last 10 yrs Cate Paull: DBM Paul Horne: IPM Barbara Hall: Stem canker Liz Minchinton: White blister Len Tesoriero: Asian vegetables pest & diseases Jenny Ekman: Asian vegetable names & postharvest/export Rachel Lancaster: mechanisation/harvesting Nancy Schellhorn: revegetation David Carey: Brassica Integrated Crop Management Toolkit CD
10.30 am	Morning tea
11.00 am	Research summaries continued
11.30 am	Identification of key research themes (e.g. soil, IPM)
11.45 am	Break into groups to identify key R&D priorities
12.30 pm	Lunch
1.15 pm	Voting on key R&D priorities
2.00 pm	Develop project ideas for the top 5 – 10 R&D priorities What is the problem? How are we going to investigate it? What outcomes are we seeking? How will we deliver it? How will it be implemented on-farm?
3.45 pm	Wrap up and close
4.00 pm	Taxis to the airport

APPENDIX 2: PROJECT SUMMARIES

Improving Market Access for Asian Vegetables (VG04031) & Evaluation of New Shipping Technologies for Australian vegetables (VG06045)

Dr Jenny Ekman
NSW DPI

Before we could even start work on Asian vegetables we had to decide what to call them, so the first part of the project involved developing a standardised system of names for these products. The second part looked at the current retail situation and consumer attitudes to Asian vegetables. Many consumers are interested in Asian vegetables and recognise them as healthy, fresh and sometimes locally grown. Despite this, lack of knowledge on how to cook them, what they will taste like, and fear of rejection by family members remain barriers to purchase. Our new project will examine ways of overcoming these barriers. This could involve value added products, information for the food industry and other strategies to increase purchases of Asian vegetables.

Work is continuing on extending storage life and maintaining quality of vegetables in order to allow sea freight to distant export markets. A successful trial export to Dubai demonstrated that, for this market, broccoli was best transported in plastic lined cartons rather than ice and that modifying the atmosphere was not necessary. Cauliflowers could also be shipped successfully in plastic. However, good temperature control is critical. We are now testing storage atmospheres, postharvest dips and other treatments to allow transport to Europe.

White Blister (VG02118, VG04013 & VG07070)

Dr Liz Minchinton
DPI, Victoria

Projects on white blister VG02118 and VG04013 have:

1. Developed the first molecular method to separate the races of *Albugo candida*;
2. Developed a seed health test sensitive to one oospore;
3. Identified cultivars of broccoli with tolerance to white blister in 3 states;
4. Evaluated the Brassica^{spot} disease predictive model to manage white blister which can reduce 80% of weekly sprays and which is economical for susceptible varieties; and
5. Evaluated and identified a range of systemic, protectant and soft chemicals for white blister control on seedlings and plants.

A current project which evolved from the 'Pathology gap analysis project', 'VG07070: Benchmarking predictive models, nutrients and irrigation for management of downy and powdery mildew and white blister' contains sections of relevant to Brassica's including a predictive model, a real-time spore trap detection kit, irrigation management, nutrition and a technology review. The new and old versions of the Brassica^{spot} model are currently being evaluated in two field trials in Victoria. No white blister has been predicted and none observed. An irrigation trial has been established at Werribee for a comparison of early morning and evening irrigation to reduce the disease pressure from white blister. It also includes the Brassica^{spot} model. The effect of nutrients, especially various sources of N, on the susceptibility of Brassica plants to white blister is under evaluation by Barbara Hall (SARDI). A review of weather station technology is currently underway by Dr Ian McCauley at DPI Atwood.

White blister on Brassica vegetables was discussed with growers, crop consultants and scientists during a recent trip to the UK and Netherlands. The Brassica^{spot} model is used extensively in the UK and Northern Europe by 60 – 70 growers. Growers reported sprays for

white blister are reduced by 50% or more. One grower recovered the cost of a weather station, with the savings he made on chemicals during the production of a single crop. Management of white blister is expected to follow that of grey leaf spot in the UK, where the model and spore trap are used in combination to enable crop consultants to make rational decisions on spray timing. A sample kit for grey leaf spot was provided for demonstration to growers. Contracts for collaboration with HRI are still in progress, but discussions with collaborators, Dr Roy Kennedy and his team at Warwick HRI, were extremely productive regarding the Brassica^{spot} model and development of the white blister specific spore trap.

Agronomic packages for reduced pass harvesting of export cauliflower (VG02051)
Export cauliflower - Alternative planting configurations (VG04008)
Use of plant growth regulators for reduced pass harvesting of cauliflower and broccoli (VG06013)

Rachel Lancaster
Department of Agriculture and Food Western Australia

The multiple harvests required to remove broccoli and cauliflower crops are expensive for growers. Both the direct cost of labour and the indirect cost of sourcing adequate and suitable labour are increasing. VG02051 and VG04008 have been recently completed and they focussed on different agronomic methods for improving the uniformity of crop maturity such as irrigation, crop nutrition and plant density. Using a combination of agronomic methods, a one pass harvest of cauliflower and broccoli crops was possible, with yields that were equivalent to a selective harvest being achieved.

The current project VG06013 is examining if plant growth regulators such as ethephon and gibberellic acid can improve the uniformity of crop harvest. If successful, the use of plant growth regulators to manage crop maturity would be used in conjunction with the agronomic methods already identified.

Brassica Integrated Crop Management Toolkit CD (VG07030)

David Carey
Queensland DPI&F

The Brassica Integrated Crop Management Toolkit CD when placed in your computer provides you with valuable tools for learning more about crop management of Brassicas. The CD contains 355 fact sheets of detailed information on crop management issues, resistance management strategies, general references and internet links to further sources of information.

A great on-farm resource, the CD also has over 450 digital photos, including insect pests and diseases of Brassicas that will assist in on-farm problem solving.

A diagnostic key allows growers to go through a check list answering short questions about any problem they see in there crop, and then produces a short list of the possible causes. This self diagnosis can then be compared to reference photos on the CD for verification and further information on management options in fact sheets

I am also involved in the Brassica best practice project that will pull together current knowledge from previous work and present an overview of the current knowledge base.

APPENDIX 3: ISSUES IDENTIFIED BY GROUPS AND INDIVIDUALS PRIOR TO THINK TANK

Abbreviations:
ICM – Integrated Crop Management
IPM – Integrated Pest Management]
IDM – Integrated Disease Management
IPDM – Integrated Pest and Disease Management
DBM – Diamondback Moth
R&D – Research & Development

Group 1 (yellow)

IPM Consultants - $ to establish more consultants and give them training	Food safety
Desktop study to identify key input costs and improved efficiency strategies	Focus on bio-rational chemicals for minor use
Revisit nutrient optimisation for Brassica vegetables	Indirect effects of herbicides and insecticides on diseases and pests (scoping study)
Low carbon production	Food miles – is it an issue?
Revegetation by design – national approach	Cross-industry integration for pest and disease management (vegetables and broadacre)

Group 2 (green)

More extension to explain ICM/IPDM	Ensure grower input in setting brassica R&D priorities
Extension, e.g. handy hints on optimising specific insecticide and fungicide spraying	Long term IPM/IDM R&D programs (expertise maintenance)
Ongoing program of DBM research & extension – continuity of current program	White blister predictive modelling – ongoing R&D program

Group 3 (orange)

IPM consultant training	Fertiliser use – mining existing nutrients, minimal application
Managing pests & diseases – communication on-farm	Communication – roadshow to regions (experts, identify key issues)
Demonstration groups, e.g. IPM, modelling, insect identification	Understanding how plant nutrition affects product quality and shelf life
Economics – cost benefits	Chemical registration – make obtaining minor use permits quicker, broaden list of crops on each chemical label
Pest & disease surveillance to foresee future problems so that industry can be prepared	Affect of plastic return crates on product quality (new design has less venting)
Overseas problems – potential pest & disease incursions	IPM adoption – not only Brassica crops grown (need to take into account other crops on-farm)
Soil health – crop rotations, compost/organic matter, cover crops, benefits to predators, $ associated with carbon off-sets	

Group 4 (pink)

ICM – where do we go to get the information we need?	Extension: IDOs, workshops/demonstrations, follow up with web and email (need good archive on web)
IPM – native vegetation/habitats, consultant/staff training in monitoring and pest recognition, understanding of IPM concepts	Application techniques – increasing application and coverage of biologicals and chemicals, efficacy and off-target effects
Soil management – tillage effects, soil amendments and rotations	Water – what is used and what is wasted (on-farm modelling)
IPM - off-target pests and increase in "cosmetic" pests and secondary pests, clone Paul Horne	Nutrients – what is used and what is wasted, on-farm modelling
IPM adoption/awareness	

Issues identified by individuals prior to the Think Tank

Encroachment of canola in WA – DBM issue, how will vegetable industry cope with incursion of DBM from canola into vegetables?	Impact of climate change on horticulture (growing regions, pests and diseases) and communication of projects currently underway
Soil amendments – do they work and need trials to get some scientific data (the facts)	Role of GM in vegetables – opportunity to control input costs and reduce pesticide use
Too much overlap from on district to another – sometimes it does not pay to harvest a crop, how do we coordinate better?	Input costs increasing, especially fertiliser – opportunity to repackage information about fertiliser use and communicate to industry (e.g. pasture workshops in WA covered how fertiliser use can be reduced, do we have our fertiliser inputs correct, alternatives to fertilisers, better application techniques, liquid versus granular fertilisers)
Salinity – how do we manage it into the future?	Transport and packaging – how can costs be reduced, better packing (more on a pallet), possibilities of using rail.
Need to focus on the survival of the vegetable grower in the near future – long term issues will not matter if we do not address certain issues now (increasing cost of production, returns, etc.)	Consumer trends – where are we heading and what should we be growing in the future to meet consumer demand
Cost of diesel and freight and the cost of converting to LPG	Outcomes of pest and disease research take too long to reach the farm – need better communication of pest and disease research, need to be prepared for new pest and diseases and outbreaks, foresee pest and disease problems and be ready, communication of where to go to get information on pests and diseases