Horticulture Innovation Australia

Final Report

Protecting Australia's citrus genetic material

Tim Herrmann
Auscitrus

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CT10008

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Fax: (02) 8295 2399

Contents

Summary

Biosecurity has been highlighted as a priority for the Australian Citrus Industry (Australian Citrus Strategic R&D Plan 2012-17). The productivity and profitability of the Australian citrus industry is dependent upon the availability of healthy, true to type propagation material of varieties with high market acceptance. There are a number of economically significant diseases of citrus which are spread via infected propagation material. There are no cures for these graft-transmissible diseases which lead to yield loss, reduced fruit quality, stunting, tree decline and death. Use of healthy planting material will avoid potential yield loss and the costly exercise of replanting infected orchards.

The Australian citrus industry enjoys a relatively high health status compared to other countries and, to date, major citrus diseases like huanglongbing, leprosis and citrus variegated chlorosis have not been reported here. However in Australia we still face a number of serious local citrus diseases, including a number of citrus viruses and viroids that are managed using healthy propagation material. The maintenance of Australia's high health status is dependent upon our quarantine system to stop infected material entering the country illegally, our post-entry quarantine system for legal import of new citrus varieties and the supply of healthy propagation material to industry. An important component of this system is the National Citrus Repository program, where foundation trees of commercially significant citrus varieties are maintained in insect-proof repositories and tested for citrus pathogens. The foundation trees provide high health status, true to type budwood to the Auscitrus propagation scheme for rapid nursery multiplication and supply of high health status, true to type budwood to nurseries for nursery tree production.

Project CT10008 'Protecting Australia's citrus genetic material' continues the work of previous projects funding the long-term repository program. Funds support the maintenance and disease testing of the foundation trees in the National Citrus Repository and the disease testing of new Australian citrus selections.

Currently 115 publicly owned citrus clones are housed in the repository, from Australian and overseas sources. Six of these were new introductions to the repository over the course of the project from 2010 to 2015; three were imported and three were local selections.

The National Citrus Repository is an industry asset that serves as an insurance policy for the future health and economic viability of the Australian citrus industry.

Keywords

citrus; germplasm management; repository; true to type; biosecurity; health status; graft-transmissible diseases

Introduction

It is important that high health status and true to type citrus propagation material is available to the Australian citrus industry to maximize orchard productivity and enable producers to remain competitive in the marketplace. There are a number of economically significant graft-transmissible diseases of citrus which cause yield loss, reduced fruit quality, stunting, tree decline and death. There are no cures for graft-transmissible diseases but they can be managed using disease-free propagation material.

The Australian industry enjoys a relatively high health status compared to other countries and, to date, major citrus diseases like huanglongbing, leprosis, stubborn and citrus variegated chlorosis have not been reported here. However in Australia we still face a number of serious local citrus diseases, including a number of endemic graft-transmissible citrus viruses and viroids that are managed using high health status propagation material.

The maintenance of Australia's high health status is dependent upon the following programs:

- the Federal Department of Agriculture post-entry quarantine system, where newly imported citrus varieties are tested for endemic and exotic plant pathogens before release;
- the National Citrus Repository program, where foundation trees of commercially significant citrus varieties are maintained in insect-proof repositories and tested for citrus pathogens – the foundation trees provide high health status, true to type budwood to Auscitrus for rapid nursery multiplication; and
- the Auscitrus propagation scheme, managed by an industry non-profit organization (Australian Citrus Propagation Association) that supplies high health status, true to type budwood and rootstock seed to nurseries for nursery tree production.

Project CT10008 'Protecting Australia's citrus genetic material' continues the work of previous projects funding the long-term repository program. Funds support the maintenance and testing of the foundation trees in the National Citrus Repository and the pathogen testing and elimination of new Australian citrus selections.

Methodology

National Citrus Repositories

The 'National Citrus Repository for High Health Status Clones' maintains foundation trees of 115 public citrus clones (Table 1 / Appendix 1). A minimum of 1 tree of each variety is held in screen houses in 2 locations at Dareton and Menangle, NSW. The Dareton repository is situated in the Sunraysia citrus growing region on the Auscitrus property. Menangle, on the outskirts of south western Sydney, is not in a citrus producing area and the repository is sited at the NSW Department of Primary Industries' Elizabeth Macarthur Agricultural Institute (NSW DPI EMAI). Repository houses are located in two different regions to provide a level of redundancy should a catastrophic event such as fire, vandalism, or disease incursion occur at one of the sites.

The 'National Repository for Inoculated Citrus Clones' contains high health status mother trees that have been inoculated with a mild strain of Citrus tristeza virus (CTV). This mild strain serves to protect against more severe strains of the virus that may be introduced to trees in the field by aphids. This management tool is called mild strain cross protection and the inoculation of trees is often referred to as 'pre-immunisation' in the international citrus literature. The inoculated trees are housed in a controlled environment greenhouse at EMAI.

Plant maintenance

The foundation trees are maintained using industry best practice. The repository houses are insect proof and have double entry doorways. Quarantine mesh is used on the screen houses at EMAI and Dareton containing the high health status foundation trees. The trees are regularly inspected for pest infestation, disease symptoms and off-type shoots. Fruit on foundation trees are observed and photographed and the images are maintained in a database. Trees are drip irrigated and fertigated. Strict nursery hygiene is observed during all management activities. Organic fertiliser is also used at EMAI. The repository houses are secure facilities with access only granted to essential staff or external auditors, with approval from Auscitrus.

A tree replacement program is in progress to create daughter trees from foundation trees that are over 20 years old.

Health status testing

Trees in the citrus repositories are tested regularly for graft-transmissible pathogens of citrus by the NSW DPI citrus pathology team at EMAI. The team moved into new QC2 quarantine laboratory facilities in 2011.

It is important to note that the high health status of repository trees means that no viruses or viroids have been detected in the trees. These trees have a high health status but pathogens may be detected in these trees through improved test methods or the discovery of new pathogens.

<u>Citrus tristeza virus (CTV)</u>

CTV is endemic throughout Australia. There are many strains of the virus from mild to severe causing a

range of disease symptoms.

Every tree in the citrus repositories is tested annually for the presence of CTV using a serological test called direct tissue blot immunoassay (DTBIA) (Garnsey et al. 1993). This test is used to confirm that the virus is not present in the high health status clones and to confirm that the virus is present in the inoculated trees.

Each year, trees in the EMAI repositories were tested for CTV in autumn and the Dareton repository trees were tested in spring.

Trees in the repository for inoculated clones that initially test positive for CTV after inoculation but which test negative for CTV during the annual testing, are tagged and re-tested. It is likely that the virus is still present in these plants but at such a low level that it escaped detection. If the tree is still found to be negative upon re-testing the tree is either re-inoculated or discarded. Budwood is only sourced from inoculated trees that have tested positive for CTV during the past year (their most recent test). Each bud stick is blotted before dispatch and tested to confirm the presence of CTV.

Citrus viroids

Citrus viroids I, II, III and citrus exocortis viroid (CEV) are known to occur in Australia. All repository trees are scheduled for testing for citrus viroid infection every 3 years. From 2010 to 2012, samples from all repository trees were tested for Citrus viroids I, II, III and CEV using molecular methods (conventional PCR) (Bernad and Duran-Vila 2006). In 2013 the samples were also tested for Citrus viroid IV by an Honours student from the University of Western Sydney (Wang et al. 2009; Wildman 2013). CVd IV is not known to occur in Australia.

Samples were collected from all repository trees from the end of October 2014 to early March 2015 for testing using molecular methods. RNA extracts have been produced from all samples and the testing of extracts for citrus viroids is in progress.

Citrus tatterleaf virus (CTLV)

CTLV is known to occur in Australia. Repository trees on susceptible rootstocks would show symptoms if infected with CTLV and therefore are considered to be self-indexing. Repository trees on tolerant (symptomless) rootstocks are tested for CTLV every 9-12 years.

Repository trees on tolerant rootstocks were tested for CTLV in 2010 using biological and molecular methods. Biological indexing involved the inoculation of samples from EMAI repository trees onto Rusk citrange indicator plants (Roistacher 1991). The samples were also tested for CTLV by conventional PCR (Hailstones et al. 2000).

New introductions to the repository

Viruses and viroids can be removed from infected mother trees by heat treatment and shoot tip grafting. Successful shoot tip grafted plants then require testing to determine if all known pathogens have been eliminated. Imported varieties are tested and undergo pathogen elimination in post-entry quarantine run by the Federal Department of Agriculture. Auscitrus provides the service of pathogen testing and elimination by shoot tip grafting for Australian selections but only pathogens known to occur in Australia

are tested for.

When an imported or locally selected variety is ‘released’, the high health status mother tree is placed in one of the repository houses at Menangle or Dareton and a daughter tree is propagated for placement in the other repository house.

Private varieties

Project CT10008 ‘Protecting Australia’s citrus genetic material’ from July 2010 to June 2015 funds the maintenance and testing of public varieties held in the National Citrus Repositories and pathogen elimination of locally selected public varieties. All work outlined in this report refers to the maintenance and testing of public varieties.

The maintenance and testing of private varieties in the repository system is covered by a contract agreement between the private variety owner and Auscitrus and is paid for by the variety owner as fee for service. There are currently foundation trees of 89 private varieties in the ‘National Citrus Repository for High Health Status Clones’.

Quality assurance

The EMAI and Auscitrus nurseries are both accredited by NIASA (Nursery Industry Accreditation Scheme Australia) and are audited by the NSW Nursery Industry Development Officer annually. The work conducted by the NSW DPI citrus pathology team has been certified by ISO 9001:2008 since 2005 and was most recently externally audited in June 2015. The EMAI repository for high health status citrus clones is also accredited as a New Zealand Ministry of Primary Industries off-shore quarantine facility for introduction of new citrus varieties to NZ. The Auscitrus EMAI management committee meets at least twice yearly at EMAI to tour the facilities and discuss the Auscitrus related work conducted at EMAI.

Outputs

National Citrus Repositories

Table 1 details the number of clones of each citrus type currently housed in the 'National Citrus Repository for High Health Status Clones'. Appendix 1 provides a full list of clones.

Table 1: The number of clones of each citrus type housed in the National Citrus Repository for High Health Status Clones (as of June 2015)

Citrus type	Number of clones
Orange	46
Mandarin	33
Tangor / tangelo	5
Papeda	5
Grapefruit	9
Pommelo	2
Citron	3
Lemon	9
Lime	2
Cumquat	1

Health status testing

No CTV was detected in foundation trees in the 'National Citrus Repository for High Health Status Citrus Clones' using DTBIA.

Most trees in the 'National Repository for Inoculated Citrus Clones' tested positive for CTV each year from 2010 to 2014 using DTBIA. All inoculated repository trees tested positive for CTV in 2015 using DTBIA.

A number of clones are known for being difficult to inoculate with a mild strain of CTV. Table 2 provides a list of citrus clones held in the 'National Repository for Inoculated Citrus Clones' where it has been difficult to detect CTV since 2010.

Table 2: Citrus clones where Citrus tristeza virus (CTV) has not been detected in inoculated repository trees

Testing year	Citrus clones where CTV not detected
2010	Afourer, Ellendale (Herps)
2011	Afourer, Ellendale (Herps), Primosole, Satsuma (Miho Wase), Bergamot
2012	Afourer, Bergamot
2013	Afourer, Ellendale (Herps)
2014	Afourer, Ellendale (Herps)

No viroids (CVd I, II, III, IV) were detected using conventional PCR in samples collected from the repository trees.

No symptoms consistent with CTLV infection were observed in repository trees on susceptible rootstocks. No CTLV was detected in repository trees on tolerant rootstocks using biological or molecular test methods.

New introductions to the repository

Table 3 outlines the new introductions to the 'National Citrus Repository for High Health Status Clones' from 2010 to 2015.

Table 3: New introductions of citrus clones to the repository system from 2010 to 2015

Accession number	Clone	Year entered repository	Source
I.N.10.0984	Palmer navel	2010	Imported
A.S.10.0985	Arnold blood orange	2010	Local
A.N.13.0991	Yuzu	2013	Local
A.N.14.0993	Cara Cara orange	2014	Local
I.N.14.0996	Queen IVIA-579	2014	Imported
I.N.15.1020	Sudachi	2015	Imported

Budwood exports

Budwood was sourced from both EMAI and Dareton repository trees over the course of the project, to establish new budwood multiplication trees for subsequent distribution of budwood to the wider citrus and nursery industry.

Budwood of 2 public varieties, Hamlin orange and Topaz tangor was exported to New Zealand in 2010 from the EMAI repository screen house for high health status clones.

Awareness material

Reports

In addition to contracted milestone reports, project activities were outlined in the following reports.

Herrmann, T., Donovan, N., Jelinek, S. 2014. Australian Citrus Propagation Association Incorporated Annual Report.

Herrmann, T., Donovan, N., Jelinek, S. 2013. Australian Citrus Propagation Association Incorporated Annual Report.

Herrmann, T., Donovan, N., Jelinek, S. 2012. Australian Citrus Propagation Association Incorporated Annual Report.

Herrmann, T., Donovan, N., Jelinek, S. 2011. Australian Citrus Propagation Association Incorporated Annual Report.

Herrmann, T., Donovan, N., Chambers, G. 2010. Australian Citrus Propagation Association Incorporated Annual Report.

Presentations

The importance of the National Citrus Repository Programme to the health status of the Australian Citrus industry was highlighted in the following presentations:

Donovan, N., Chapman, T. 2015. Ready to respond to disease threats. Citrus Technical Forum and Field Day, Mildura Victoria Australia, 16th to 17th March 2015.

Donovan, N. 2015. Citrus Disease Threats. Citrus Biosecurity Workshop. Dareton, New South Wales Australia, 20th May 2015.

Donovan, N. 2015. Citrus Disease Threats. Citrus Biosecurity Workshop. Loxton, New South Wales Australia, 19th May 2015.

Donovan, N. 2015. Citrus Disease Threats. Citrus Biosecurity Workshop. Griffith, New South Wales Australia, 3rd March 2015.

Donovan, N. 2014. Save Your Citrus. Australian Museum Science Festival Community Day. Sydney, NSW Australia, 16th August 2014.

Donovan, N., Herrmann, T., Jelinek, S. 2013. Managing Biosecurity risks to Australian citrus. 19th confererence of the International Organisation of Citrus Virologists. South Africa 28th July to 2nd August 2013.

Donovan, N., Burdette, S. 2012. Infected seed and budwood. Citrus Australia National Conference. Leeton, New South Wales Australia, 21-23 October 2012.

Extension article

Cutting edge tests keep citrus healthy. Wollondilly Advertiser, October 2013.

Outcomes

The benefits of this project include the maintenance of a genetic resource of citrus material of the major commercial publicly owned citrus varieties. This will flow on to the Australian citrus propagation scheme where this health tested material will be multiplied and distributed to nurseries and growers around Australia. The citrus industry will benefit from increased productivity through the use of disease free planting material, along with improved biosecurity as the risk of spreading economically devastating graft transmissible diseases is reduced.

The National Citrus Repository will be invaluable in the event of an incursion of an exotic disease like huanglongbing, as it will provide a source of high health status genetic material protected from insect vectors of the disease.

Evaluation and Discussion

It is critical to the longevity of the Australian citrus industry that biosecurity strategies focus on disease exclusion, particularly given the number of diseases for which there is no cure. Therefore it is essential that industry has access to healthy propagation material of commercially significant varieties.

Project CT10008 'Protecting Australia's citrus genetic material' has funded the 'National Citrus Repository for High Health Status Clones' and the 'National Repository for Inoculated Citrus Clones' from 2010 to 2015. Foundation trees in the repositories have been maintained and managed to reduce the risk of infection by graft-transmissible diseases and their high health status has been confirmed by regular testing. Healthy propagation material has been supplied to Auscitrus for propagation of daughter trees and supply of healthy budwood to industry.

New varieties have been introduced to the repository after release of legal importations from post-entry quarantine and of Australian selections from the pathogen elimination and testing program at EMAI. The impact of this project extends beyond the national industry, with the EMAI repository also serving as an off-shore quarantine facility for introduction of new citrus varieties to New Zealand.

The maintenance of citrus repository facilities in two locations has provided functional redundancy to the system. The foundation trees have served as a readily available source of health tested, true to type propagation material to rebuild the industry in the event of an incursion of an emergency plant pest. The repository is an insurance policy for the Australian industry.

The project team has contributed to growing awareness of the importance of the use of health tested propagation material through reports to industry and presentations at industry forums to growers, nurserymen, service providers and other relevant stakeholders.

This project has successfully contributed to the maintenance of the high health status of the Australian citrus industry as one component of an integrated biosecurity strategy. The repository program should be considered an ongoing commitment, with a long term view to the maintenance of this industry asset.

Although some of the worst citrus pathogens, like huanglongbing, are not known to occur in Australia, they still pose a significant threat given the likelihood of an incursion. Huanglongbing and insects associated with its transmission are found in close proximity to Australia on the Indonesian archipelago and in New Guinea. There is considerable visitor traffic into Australia from other countries where the disease is also present. Movement of infected plant material or insect hosts into Australia is highly likely via cyclonic winds or illegal importations. The biosecurity risk to the Australian industry from graft-transmissible citrus diseases would be further reduced by:

- screening the Auscitrus supply trees to protect them in the event of an incursion;
- the introduction of a mandatory certification scheme across all states and territories governing the use of health tested propagation material; and
- a nursery registration system to allow the tracking of 'at risk' commodities like citrus and orange jasmine.

These initiatives will only be successful if supported by industry and, in conjunction with existing biosecurity strategies, will help to maintain the high health status of Australian citrus germplasm and allow industry and government to respond efficiently to disease threats.

Recommendations

- This project should be considered an ongoing commitment, with a long term view to the maintenance of this industry resource.
- The value of the citrus repositories should be recognized in industry biosecurity plans as a resource of high health status material available in the event of an incursion of an exotic graft transmissible disease.
- To maximise the return on this investment, the use of high health status propagation material supplied from daughter trees of this repository via the Auscitrus budwood scheme should be supported by the citrus industry and actively promoted to growers.
- The National Citrus Repository program is one component of an integrated biosecurity program. It is recommended that protecting the Auscitrus supply trees and the introduction of nursery registration and mandatory use of health tested propagation material would enhance the ability of the Australian citrus industry to maintain its high health status and combat disease threats.

Scientific Refereed Publications

Paper in conference proceedings

Donovan, N., Herrmann, T., Jelinek, S. Managing Biosecurity Risks to Australian Citrus. In: Proceedings of the 19th conference of the International Organisation of Citrus Virologists, Kruger National Park South Africa 28th July to 2nd August 2013.

Research thesis

Wildman, O. 2013. Developing molecular diagnostics for citrus viroids. Honours thesis, University of Western Sydney, Australia.

Intellectual Property / Commercialisation

No commercial IP generated.

References

Bernad, L., Duran-Vila, N. 2006. A novel RT-PCR approach for detection and characterization of citrus viroids. Molecular and Cellular Probes 20: 105-113.

Garnsey, S.M., Permar, T.A., Cambra, M., Henderson, C.T., 1993. Direct tissue blot immunoassay (DTBIA) for detection of citrus tristeza virus (CTV). In: P. Moreno, J. Da Graça and L.W. Timmer (Eds), Proceedings of the 12th Conference of the International Organisation of Citrus Virologists. Riverside, California USA. pp. 39-50.

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Roistacher, C.N. 1991. Graft Transmissible Diseases of Citrus. International Organization of Citrus Virologists, FAO. Riverside, California USA. pp. 99-104.

Wang, X., Zhou, C., Tang, K., Zhou, Y., Li, Z. 2009. A rapid one-step multiplex RT-PCR assay for the simultaneous detection of five citrus viroids in China. European Journal of Plant Pathology 124(1): 175-180.

Wildman, O. 2013. Developing molecular diagnostics for citrus viroids. Honours thesis, University of Western Sydney, Australia.

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The authors would like to acknowledge Ossie Wildman (Honours student, University of Western Sydney, Hawkesbury) and his academic supervisors Associate Professor Paul Holford (USW, Hawkesbury) and Grant Chambers (NSW DPI) for their contribution to molecular diagnostics for citrus viroids.

Appendices

Appendix 1: Public Varieties and Clones in the National Citrus Repository for High Health Status Clones (June 2015)

Appendix 2: Images illustrating the National Citrus Repository program

Appendix 1: Public varieties and clones in the 'National Citrus Repository for High Health Status Clones' (June 2015)

Accession No.	Variety
Grapefruit	
I.N. 91.0736	Flame
I.N. 89.0620	Henderson
A.N. 73.0068	Marsh (3970 Druitt)
A.N. 91.0632	Marsh (3962 Druitt)
I.N. 89.0619	Ray Ruby
I.N. 89.0708	Rio Red
I.N. 89.0709	Star Ruby
A.N.04.0950	Star Ruby (Cant)
A.N. 91.0633	Thompson (N Eagle)
Pummelo	
I.N. 01.0925	Namroi
I.N. 94.0786	Tambun
Citron	
I.N. 01.0926	Bergamia Bergamot Castagnaro
I.N. 94.0904	Buddha's Hand
I.N. 09.0979	Etrog
Lemon	
I.N. 01.0927	Eureka (Allen)
A.N. 75.0034	Eureka (Lambert)
A.N. 75.0035	Eureka (Taylor)
I.N. 89.0703	Fino
A.Q. 93.0785	Lemonade

Accession No.	Variety
Lemon cont.	
I.N. 00.0918	Lisbon (Limoneira 8A)
I.N. 75.0036	Lisbon (Prior)
A.Q. 91.0631	Lisbon (Queensland)
I.N. 89.0705	Verna
Lime	
A.N. 08.0969	Tahiti lime
A.N. 90.0771	West Indian lime (Schweppes)
Orange	
Navel	
I.N. 86.0600	Atwood
A.Q. 78.4021	Benyenda - thorny
A.N.14.0993	Cara cara new
I.N. 86.0597	Fisher
I.N. 99.0912	Fukumoto
A.S. 75.5077	Hockney
A.N. 73.0073	Houghton
A.S. 92.0772	Hutton
A.N. 75.0032	Lanes Late 3976
A.N. 73.0072	Leng
A.V. 94.0781	Lloyd/3 Leng
I.N. 86.0550	Navelate
I.N. 87.0546	Navelina Spain 7.5
I.N. 93.0899	Navelina 315 ex Italy
A.S. 92.0773	Neilson
I.N. 86.0598	Newhall California

Accession No.	Variety
Orange *Navel* cont.	
I.N. 87.0551	Newhall 55-1 Spanish
I.N. 10.0984	Palmer 1051
A.S. 75.5074	Thomson
Valencia	
A.S. 75.5095	B/3010
A.Q. 75.4022	Benyenda
A.S. 94.0782	Berri 3501
A.V. 94.0780	CSIRO 5
A.V. 93.0774	Jenner 4439
A.N. 75.0029	Newton – Keenan 3125
A.N. 75.0030	Newton – Keenan 3247
Other	
I.N. 92.0901	Acidless orange (Lima 156)
A.S. 10.0985	Blood orange (Arnold blood)
I.N. 98.0921	Blood orange (Sanguine)
I.N. 08.0968	Blood orange (Tarocco Ippolito)
I.N. 07.0965	Blood orange (Tarocco Meli C8158)
I.N. 07.0966	Blood orange (Tarocco Rosso C4977)
I.N.06.0960	Common orange (Bintangcheng # 2)
I.N. 08.0973	Common orange (Bintangcheng Renbin # 5)
I.N. 94.0902	Common orange (Delta seedless)
I.N. 86.0548	Common orange (Hamlin)
I.N.06.0959	Common orange (Jincheng 447)
I.N. 94.0903	Common orange (Midknight)

Accession No.	Variety
Orange *Other* cont.	
I.N. 92.0900	Common orange (Natal)
I.N. 86.0549	Common orange (Parson Brown)
I.N. 90.0741	Common orange (Pera Olympia)
I.N. 90.0742	Common orange (Pera Limeira)
I.N. 87.0547	Common orange (Pineapple)
I.N. 93.0860	Common orange (Salustiana)
A.Q. 78.4020	Common orange (Smith - Joppa)
I.N. 97.0924	Pigmented navel (Cara Cara)
Mandarin	
I.N. 99.0909	Afourer
I.N. 99.0913	Avana Tardivo
I.N. 99.0914	Avana Apireno
I.N. 98.0920	Clementine (Caffin)
I.N. 89.0704	Clementine (Clementard)
I.N. 99.0910	Clementine (Corsica 1)
I.N. 99.0911	Clementine (Corsica 2)
I.N. 87.0544	Clementine (Fina)
I.N. 87.0552	Clementine (Marisol)
I.N.05.0957	Clementine (Nour)
I.N. 87.0543	Clementine (Nules)
I.N. 04.0955	Clementine (Orogrande)
I.N. 87.0545	Clementine (Oroval)
I.N. 04.0953	Clementine (Sidi Aissa)
I.N. 91.0733	Daisy

Accession No.	Variety
Mandarin cont.	
I.N. 90.0736	Encore
I.N. 08.0974	Etna
I.N. 89.0707	Fallglo
I.N. 93.0859	Fortune
A.Q. 94.0787	Fremont
A.N. 75.0041	Hickson
A.N. 75.0043	Imperial 0043/2
A.Q. 94.0778	Nova (Trott)
I.N. 91.0734	Nova (Spain)
I.N. 04.0951	Parsons Special /2
I.N. 86.0599	Pixie
I.N. 04.0954	Primosole
A.N. 75.0065	Satsuma (Silverhill)
I.N. 89.0706	Satsuma (Clausellina)
I.N. 91.0852	Satsuma (Okitsu Wase)
I.N. 91.0853	Satsuma (Miho Wase)
I.N. 14.0996	Satsuma (Queen IVIA-579)
A.Q. 94.0886	Sunburst
Tangor/elo	
A.N. 75.0090	Ellendale (Herps)
	Ellendale / EM3
A.Q. 04.0952	Murcott tangor (Benham)
A.Q. 90.4149	Murcott tangor (Turner)
I.N. 90.0818	Topaz tangor

Accession No.	Variety
Papeda	
I.N. 94.0776	Kaffir lime (Malaysia 4669)
A.D. 97.0907	Kaffir lime (Nathanael)
I.N. 00.0916	Kaffir lime (Eyles)
IN. 15.1020	Sudachi
A.N. 13.0991	Yuzu
Cumquat	
I.N. 04.0956	Nagami

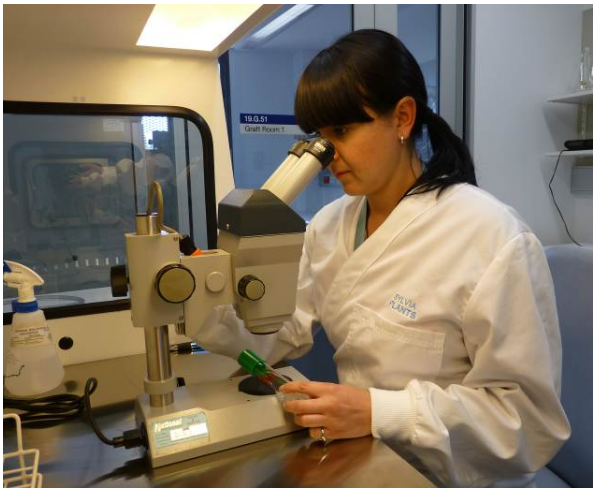
Appendix 2: Images illustrating the National Citrus Repository program

(a)

(b)

National Citrus Repository screen houses for High Health Status Clones (a) Dareton (b) EMAI, Menangle

Foundation tree of imported variety Sudachi on release from post-entry quarantine, May 2015



Sylvia Jelinek (Technical Officer, NSW DPI) inspecting a shoot tip graft as part of the pathogen elimination process at the NSW DPI EMAI Plant Pathology laboratory facility