RIRDC Completed Projects in 2011–12 and Research in Progress at June 2012

New and Developing Plant Industries
NEW AND DEVELOPING PLANT INDUSTRIES

RIRDC Completed Projects in 2011–12 and Research in Progress at June 2012

January 2013

RIRDC Publication No. 12/083
Foreword

RIRDC produces summaries of completed and continuing projects for each financial year. Our intention is to:

- provide stakeholders with early access to the results of ongoing and completed work to inform their decisions, and
- inform researchers of results to shape research direction.

The New and Developing Plant Industries Completed Projects 2011–12 and Research in Progress at June 2012 contains short summaries of projects funded by the Program. The Program aims to facilitate the development of new and emerging industries based on plant or plant products that have commercial potential for Australia.

The New and Developing Plant Industries Program is divided into seven categories. These are:

1. Native Foods
2. Culinary herbs, spices and beverages
3. Extractive and fibre crops
4. Fruit, vegetables and nuts
5. Grains and pulses
6. Cultural and World Foods
7. Miscellaneous
8. Ginger

This report is an addition to RIRDC’s diverse range of over 2000 research publications most of which are available for viewing, free downloading or purchasing online at www.rirdc.gov.au. Purchases can also be made by phoning 1300 634 313.

Craig Burns
Managing Director
Rural Industries Research and Development Corporation
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### Completed Projects - Native Foods

**PRJ-005855 Australian Native Food Industry Stocktake**

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<tbody>
<tr>
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<tr>
<td>Researcher:</td>
<td>Michael Clarke</td>
</tr>
<tr>
<td>Organisation:</td>
<td>AgEconPlus Pty Ltd</td>
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<tr>
<td>Email:</td>
<td><a href="mailto:clarke@ageconplus.com.au">clarke@ageconplus.com.au</a></td>
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**Objectives**

- To prepare a robust stocktake and situation assessment of the Australian native foods industry.
- To analyse situation assessment findings and determine implications for R&D and strategy development.
- To deliver a survey questionnaire that could be used in the future to update the stocktake.
- To deliver a simple industry database of willing contacts.

**Background**

The Australian native foods industry stocktake was a joint initiative of RIRDC and the Australian Native Food Industry Limited (ANFIL). ANFIL is the peak body for the Australian native food industry. The stocktake was funded with RIRDC core funds provided by the Australian Government.

**Research**

The study was completed using a combination of literature review, consultation and analysis. Key data was provided with the assistance of the industry supply chain including product aggregators and processors.

**Outcomes**

In 2010 the Australian native food industry was small, vibrant and diverse. Gross value of production at the ‘farm gate’ was between $15 million and $25 million and value adding may increase this estimate by up to 500%. Industry employment was estimated at between 500 and 1,000 persons and up to half of these individuals were Indigenous people living in remote communities. The industry is dominated by the production of lemon myrtle and to a lesser extent bush tomato and mountain pepper. Findings from the native food stocktake include:

- Commercial native food production takes place in all Australian states and territories and there is an equal number of tropical or semi-tropical ‘rainforest’ species and arid or semi-arid ‘desert’ species.
- Overwhelmingly native foods are used as raw material for processed foods.
- Production across twelve of the thirteen priority species averaged a modest eight tonnes per annum in 2010.
- Production variability is an issue for the native foods industry – it is very difficult to commit to customers when production is available one year but not the next.
- Producers were asked about the production outlook for their enterprise and their species as a whole as part of the stocktake survey. Most indicated that the supply outlook through to 2016 was either stable or that modest production increases were planned.
- For most native food species production tends toward oversupply for current niche markets but undersupplied for potential scale based opportunities.
- Native food production enterprises are typically small and grow a range of crops.
- Native food producers service farmer markets, online sales, processors, wholesalers and a range of domestic retailers. Noteworthy is the number and importance of Australian native food export markets.
| **Implications** | The involvement of Indigenous people in the native foods industry is strongest in the wild harvest species - wattleseed, bush tomato and Kakadu plum. R&D already completed by RIRDC on behalf of the industry is valued. Industry believes that research funded by RIRDC and others has prevented Australian grown native foods from sliding into a least cost commodity status from which producers would not be able to compete. R&D priorities for the period through to 2017 are identified in relation to: production; post-harvest, food safety and quality assurance; product information and market access; and communication, capacity building, extension and industry analysis. Review of stocktake findings results in recommendations for industry strategy in relation to:

- Communication of stocktake findings to government;
- Increasing the membership of ANFIL;
- Developing of new industry partnerships; and
- Encouraging information recording and sharing.

This study has provided tools including a questionnaire and a database that will allow the industry to complete an update of the stocktake in the future. |
| **Publications** | The Stocktake report will be published by RIRDC. |
**Completed Projects - Native Foods**

**PRJ-006736 Native foods compositional data for FSANZ Nutritional Panel Calculator**

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<tr>
<td>Researcher:</td>
<td>Chris Read</td>
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<tr>
<td>Organisation:</td>
<td>Australian Native Food Industry</td>
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<tr>
<td>Email:</td>
<td><a href="mailto:cd_read@intas.net.au">cd_read@intas.net.au</a></td>
</tr>
</tbody>
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**Objectives**

In order to provide FSANZ with good quality data on the seven additional species, to add to the Nutritional Plant Calculator (NPC), this project will:

- Develop (through consultation with key industry participants, FSANZ and the National Measurement Institute (NMI)) a sampling protocol to ensure representative, good quality product of commercial grade is utilised for analysis.
- Coordinate the acquisition and presentation of sample material for analysis.
- Collate and document all supplementary information required for the FSANZ analytical program.
- Engage the services of NMI – a Federal Government analytical facility in Melbourne to conduct analysis and prepare tables suitable for submission to FSANZ.
- Liaise with representatives of FSANZ to ensure incorporation of this data and existing nutritional data into the NPC database as soon as possible.

**Background**

The FSANZ nutritional database does not include data for many of the native food products the industry regards as having significant commercial value. Some data has been derived by individuals for their own use, but FSANZ requires standard sampling and analytical procedures to be followed before the data can be used in its database or for the online Nutritional Panel Calculator.

**Research**

This research project developed a sampling protocol, coordinated delivery of commercial quality samples to the Nutritional Measurement Institute, in Melbourne, which then derived standardised nutritional information for the selected species. This data was then collated, combined with other sampling information and presented as a dossier to FSANZ. Products examined were: satinash, river mint, sea parsley, bush tomato, kakadu plum, saltbush, strawberry gum, lemon and anise myrtle, native pepper leaf and berry, desert limes, fingerlimes and lemon aspen.

**Outcomes**

FSANZ scientists assessed the dossier for consistency with other similar food types, and after some minor reviews uploaded all data onto the FSANZ Nutritional Panel Calculator database, where it is now available for use by the public. [http://www.foodstandards.gov.au/foodstandards/nutritionpanelcalculator/](http://www.foodstandards.gov.au/foodstandards/nutritionpanelculator/)

**Implications**

The availability of this information within the NPC will enable food processors, chefs, manufacturers and other value-adders to confidently include these ingredients in their recipes, since they will be able to derive reliable nutritional panels to meet labelling requirements.
Completed Projects - Extractive & Fibre Crops

PRJ-004837 An alternative approach to biorefinery - A K-pulping process

Start Date: 30/05/2010
Finish Date: 19/12/2011
Researcher: Bill Doherty
Organisation: Queensland University of Technology
Email: w.doherty@qut.edu.au

Objectives

Enviro Fibre and QUT have been investigating an alternative biorefinery approach that in the short-term (unlike other proposed biorefineries) start to deliver revenue for investors. This approach aims to:

(a) produce sorghum and *Arundo donax* pulps, and fertiliser
(b) produce cellulosic ethanol
(c) have zero effluent discharge and
(d) reduce the carbon footprint.

The project proposal will evaluate technologies and demonstrate an economically viable small scale industrial process to produce market pulp and good quality fertiliser. The laboratory/pilot investigation will demonstrate a pulping process which uses chemicals of very low net cost, since the spent chemicals can be converted to a fertiliser. This project seeks to realise its objectives through the following activities:

- Optimise and demonstrate potash/additive fractionation of sorghum/*Arundo donax* to pulp and black liquor for conversion to fertiliser.
- Optimise bleaching and operating conditions of the pulps to achieve the right brightness for the manufacture of towelling products.
- Demonstrate the production of towelling products using sorghum/*Arundo donax* pulps in a commercial paper machine.
- Optimise and demonstrate the chemical conversion of black liquor to produce organic-inorganic fertiliser.

Background

Weediness warning: While *Arundo donax* showed significant promise as a successful, hardy fibre source, it is important that anyone wishing to take this research further is aware that growing this species could have significant management and environmental costs related to its potential weediness.

The Rural Industries R&D Corporation understands that *Arundo donax* has been declared as a weed in a number of areas in Australia. Therefore, people intending to use or work with this species should check with relevant authorities regarding its intended use.

The project was approved on the basis that a preliminary study on potash pulping of *Arundo donax* and Sweet Sorghum be conducted before a more comprehensive undertaking to produce market pulps and organic-inorganic-based fertiliser from Sweet Sorghum and *Arundo donax*. The aim of the preliminary study was to conduct a laboratory evaluation and optimisation of potash pulping technology; specifically determining the residual lignin content (i.e. kappa number), pulp yield and pulp strength. In addition to this approved study, some preliminary study on the bleaching of the pulps has also been completed.

Research

- Pulps from Sweet Sorghum and *Arundo donax* have the potential to be made into tissue products.
- The pulp yield of Sweet Sorghum (51.7%) is high for an agricultural fibre and
that of *Arundo donax* (43.8%) is slightly lower.

- Unbleached *Arundo donax* has excellent drainage properties of 670 CSF, while unbleached Sweet Sorghum has good drainage properties of 610 CSF. Unbleached bagasse pulp, which is used locally for tissue manufacture, is 390 CSF.

- *Arundo donax* produced the thickest handsheets with a value of 169 µm compared to a value of 164 µm and 113 µm for Sweet Sorghum and bagasse sheets respectively.

- The tensile strength of unbleached Sweet Sorghum pulp (4.46 km) is comparable to unbleached hardwood pulp (3.15 km). The value obtained for unbleached *Arundo donax* is 2.18 km, which is very low. In most paper products, high tensile strength is advantageous; however low tensile may be desirable for many tissue applications because it improves the softness of the product.

- The modulus of unbleached Sweet Sorghum hand sheets is 35 MPa the value for *Arundo donax* is 25 MPa.

- The brightness of both unbleached Sweet Sorghum and *Arundo donax* are higher than that of bagasse.

### Outcomes

This preliminary study has determined that it is possible to pulp Sweet Sorghum and *Arundo donax* to a kappa number below 20 using potassium hydroxide and Anthraquinone. This extent of lignin removal indicates that the pulp can be bleached to a brightness that is suitable for tissue manufacture. The pulp yield is equivalent or higher than literature values and typical for agricultural fibre which accounts for up to 10% of global paper production. Both Sweet Sorghum and *Arundo donax* pulps are comparable to bagasse pulp used by industry.

### Implications

It is estimated that Australia spends over $50-100 M per annum on imported paper products made from agricultural fibres. These products could potentially be derived from Sweet Sorghum/*Arundo donax* pulps. The balance of the trade deficit in the forestry sector ($1.8 billion per annum) is mainly imported paper products based on wood. There is the potential that a percentage of this market can be taken over by products derived from *Arundo donax* and Sweet Sorghum produced in Australia. Apart from the local markets, within the nearby Asia Pacific region (Particularly China), demand for paper products is expected to grow at 6% to 12% per annum. Sweet Sorghum and *Arundo donax* pulps obtained from the project technologies can potentially be used to replace short fibre pulps normally derived from hardwood (e.g. eucalyptus).

### Publications

This project was discontinued therefore no publications are available.
Completed Projects - Extractive & Fibre Crops

PRJ-007348 An overview of the Potential for an Australian Plant Fibre Industry

Start Date: 10/05/2011
Finish Date: 21/10/2011
Researcher: Adrian Best
Organisation: Synerge Pty Ltd
Email: bestadrian@mac.com

Objectives
Synerge, AgEconPlus, and CSIRO (Materials Science and Engineering - Geelong) will work together to jointly undertake a desktop scoping study and research on the available fibres in Australia and their commercial value that will seek to identify the following:

- Available Australian fibre sources concentrating on plant fibres from industrial hemp, flax, oil seed straw, kenaf, Bagasse from sugarcane, fibres from banana stem, bamboo fibres and potential new plant fibre crops.
- Estimation of the availability of each type will be undertaken and will include quantity, variety (species), geographical distribution and concentrated areas of growth (say radius of 50km). This is very important for economical fibre extraction.
- Fibre extraction technology required for each plant fibre type, existing commercial technologies and new technologies that need to be developed and also fibre quality in relationship to extraction technology.
- Fibre characteristics and yield and the plant fibre characteristics/quality of each fibre type, their intrinsic properties; and the effects of different fibre varieties.
- Fibre testing, including what tests are recommended, and existing tests that can be adapted, and potentially new tests to be developed.
- Applications - product streams and potential products from each plant fibre type and the opportunity for replacements of existing products; new products and applications and the processing technology required for each product.
- Product characteristics and features of new products and their benefits over existing products and the market size of each product/stream including any available supply chain economic data and production costs of competing fibres and their marketing and distribution.

Background
Environmental concerns, effects of climate change and consumer demands for ‘green’ products; technological advancements and higher costs for other competitive manufacturing inputs such as plastics, have contributed to the increased competitiveness of plant fibre products. The use of plant fibre is becoming a valuable input into a variety of further manufacturing products and enabled growth of the industry.

Research
This report is a desktop scoping study, providing information to assist in the discussion and strategic assessment of the potential for a high value, speciality Australian Plant Fibre industry. It contains information of a commercially confidential nature and is designed for use within RIRDC (not for wider industry dissemination). The existing plant fibre industry (excluding commercial cropping such as cotton) in Australia is almost non-existent with limited commercial production compared to other countries, and the development of a new Plant Fibre Industry presents an opportunity for Australia to be competitive in products meeting the needs of consumers in international markets. There is
potential for Australian agriculture to supply plant fibre to meet the needs of an Australian plant fibre industry. The diversification and value adding of a range of existing agricultural crops and plants across all areas of rural and regional Australia may provide economic returns to growers.

Outcomes

The project identified Australian plants and crops suitable for fibre extraction and the further uses of the fibre in manufacturing processes. It underpins an approach to further research and engagement of industry through a 5-Year Plant Fibre Industry Strategic Plan, an opportunity for Australian manufacturing to gain a competitive advantage in environmentally sustainable manufacturing and production across a wide range of industries. A practical implication of this research is that growers may have opportunity to add value to their operations under changing environmental conditions including increased climate variability. What is not clear from the results of this current study is the competitive position of an Australian Plant Fibre Industry compared with international competition; or what changes to our existing markets will occur through increasing consumer awareness, sentiment and international legislation on more green manufacturing technologies, products and services.

While it is unlikely that a fashion fibre industry would be economically competitive, the development of a plant fibre industry based around hard composites, insulation and industrial weaves could be viable.

Implications

The future of natural fibre-based composite materials will be very exciting and dynamic. It will be driven by traditions, trends, costs, performance, availability of resources, and legislation. Of these, the most critical issue is cost. However, concepts of sustainable development are changing the profit structure focused not only on the profit margin, but developing sustainable industry. There is no question that renewable, recyclable and sustainable resources will play a major role in future world developments. Existing natural fibre-based composite markets will continue to grow, but the real excitement will come in totally new markets. The initial results of the desktop study support further investigation, planning and research into the opportunities presented by an Australian plant fibre industry. A five-year Australian Plant Fibre Industry Strategic Plan may be useful to identify pathways for industry development, engagement of farmers to meet the commercial needs of fibre extraction and investment opportunities that facilitate development of the industry. It would guide rural and regional farming communities and wider industry sectors in opportunities to value add existing crops and establish timeframes for building the capacity to supply suitable agricultural waste for fibre extraction. Knowledge derived from this sector may help governments to better plan regional development opportunities including those arising from climate change mitigation including carbon sequestration. Producing a Strategic plan will inform, guide and support Australian manufacturers in developing new products and opportunities for replacing imports meeting consumer and international markets requirements in environmental and sustainable commercial production and manufacturing.

Publications

NIL
PRJ-002333 Tropical exotic fruit industry - strategic direction setting

**Start Date:** 30/06/2008  
**Finish Date:** 19/12/2011  
**Researcher:** Yan Diczbalis  
**Organisation:** The State Of Queensland Acting Through The Department of Employment, Economic Development and Innovation  
**Email:** yan.diczbalis@dpi.qld.gov.au

**Objectives**

The project objectives are to assist the Tropical Exotic fruit industry to develop a data base of tree numbers and an estimate of industry value and which exotic fruits are at the forefront of commercialisation. A specific objective of the project will be to develop a cyclone risk and protection strategy which will include mapping areas at risk as well as detailing aspects of crop agronomy, diversification and also growing location. Both major growing areas are subject to the incidence of severe cyclones which can have a significant effect on production.

The project also reviewed the need to upgrade existing strategic plans for rambutan, mangosteen and durian. The information gained above will be used to develop an overarching TEFA strategic plan which can be used to direct research, development and extension activities for the next five years. The strategic plan will also be of significant value to industry development partners in federal and state research and development agencies.

**Background**

The Australian Tropical Exotic Fruit Industry remains in recovery mode from the devastating effects of Cyclone Larry (March 2006) on a major production area, from Tully to Cairns, in north Queensland. The direct effect of Cyclone Larry on production and economic return has had follow-on effects on the community of tropical exotic fruit producers with many growers retreating to their farms to do what they can to remain viable. As a result the development of TEFA, an amalgamation of growers from north Queensland and the NT, which began prior to Cyclone Larry, ceased once growers were faced with survival as the economic reality.

**Research**

The project carried out an industry survey, tree stock take and a calculation of industry value. Growers participated in upgrading existing crop specific strategic plans as well as developing an “industry” plan.

**Outcomes**

The industry is represented by nine primary commercial crops and a further 11 secondary crops. Existing industry plans were upgraded and a industry direction plan developed.

**Implications**

The work carried out in this project allows the industry to re group and reform following the devastation caused by cyclone Larry to industry production and morale. The tropical exotic fruit industry can claim to be an important industry providing income diversification opportunities in northern Australian rural communities.

**Publications**

RIRDC Publication 12/050  
03 July 2012
# Completed Projects - Fruit, Vegetables & Nuts

## PRJ-006577 Collation of health literature for tropical and exotic fruits and extracts

| Start Date | 31/08/2011 |
| Finish Date | 31/05/2012 |
| Researcher | Kent Fanning |
| Organisation | The State of Queensland acting through the Department of Agriculture, Fisheries and Forestry |
| Email | kent.fanning@deedi.qld.gov.au |

### Objectives
- To collate compositional and health literature for tropical and exotic fruits, with a focus on information from Australian grown produce.
- To highlight where cultivars, growing practices and supply chain handling may differentiate Australian grown fruits from fruit from other countries.
- To identify opportunities for extracts to be developed from fruit or non-edible parts of fruit trees to be used in food and/or nutraceutical and/or pharmaceutical products.
- To recommend further research and development activity that would help support further knowledge of the compositional and health benefits of Australian grown tropical fruit.

### Background
Research into nutrient content, phytochemical content and health properties of tropical exotic fruits has traditionally been far less than the work done on temperate fruits. There is also little known about how Australian grown fruit compare with that of fruit grown overseas. Furthermore both edible and non-edible fruit and plant parts used in traditional medicine may have commercial opportunities for Australian producers.

### Research
In this project there was an extensive review and collation of the nutrient and phytochemical content of tropical exotic fruits, the evidence for health effects from consumption of these fruit and the use of extracts from edible and non-edible parts of these plants. The knowledge on Australian fruit was compared with that grown overseas.

### Outcomes
The vitamin C content of the fruits was generally high and specific health benefits associated with fruit consumption had been confirmed in efficacy tests, from collation of literature from USDA and NUTTAB nutrient databases, for several of the studied fruits. There was very little information on Australian fruits compared to fruits grown overseas but recent research activities show the interest of Australian research groups in studying the content and bioactivity of Australian grown fruit. Achachairu was identified as one fruit with good prospects for utilisation in extracts for food or nutraceutical uses.

### Implications
The information in this report may indicate potential species for value adding on the nutrient content and benefits of fruit.

### Publications
Completed Projects - Cultural and World Foods

PRJ-000857 Commercialisation of Mume in Australia

| Start Date: | 30/05/2007 |
| Finish Date: | 30/05/2012 |
| Researcher: | Bruce Topp |
| Organisation: | The State Of Queensland Acting Through The Department of Employment, Economic Development and Innovation |
| Email: | bruce.topp@dpi.qld.gov.au |

**Objectives**
Collect and analyse data from two statistical Mume varietal field trials and recommend suitable varieties for temperate and subtropical production.
Facilitate the plantation of commercial Mume orchards and development of linkages between growers and manufacturers of Mume-based products.

**Background**
In Asia, the small tart fruit of Mume (*Prunus mume*) is widely grown and processed into a wide variety of goods including dried fruit, pickles and drinks. Mume has been grown in Japan for over 2,000 years and has a long history of use in traditional medicine and as a health food. Fruiting cultivars of Mume are not grown commercially in Australia, although there is interest from the local manufacturing industry. Interest has intensified with reports of the possible health benefits that may be derived from inclusion of Mume products in diet.

**Research**
Five Mume cultivars were imported into Australia and tested in a range of temperate and subtropical locations. Mume propagating material was distributed to 14 sites in five states. Highest yields in the statistical trials were recorded for ‘Ianji’ equivalent to 20 tons/ha. ‘Nankou’ was preferred for umeshu production but ‘Bungo’ and ‘Dahching’ were also suitable.

**Outcomes**
This project has demonstrated that Mume can be produced in Australia. It is recommended that Mumes be grown in areas that receive adequate winter chilling but without freezing temperatures. Further trialling of the Japanese cultivars is required to determine their cropping potential in frost-free sites. Fruit from the first commercial Mume orchards in Australia has been successfully processed by our commercial partner into umeshu (Mume wine).

**Implications**
Mume production and manufacture should proceed cautiously as contracts for fruit use are negotiated and initial testing of Australian umeshu products are confirmed. Future development of Australian Mume industry will occur through strong linkages to companies who have expertise in Mume product manufacturing and fully developed supply chains for current markets.

**Publications**
Completed Projects - Miscellaneous

PRJ-002426 Further development of the stevia natural sweetener industry

| Start Date:          | 30/05/2009 |
| Finish Date:         | 27/04/2012 |
| Researcher:          | David Midmore |
| Organisation:        | Central Queensland University |
| Email:               | d.midmore@cqu.edu.au |

Objectives

There are five main objectives and research avenues proposed for this project, the first four will be addressed under the current project proposal, the fifth, which will require additional resources and time, will be undertaken if RIRDC wish to make a variation to the project once FSANZ approval for the use of steviol glycosides as intense sweeteners is forthcoming:

1. Further development of technology based on near infrared spectroscopy (NIRs) scanning for rapid assay of glycoside content in plant material for use in variety selection work and for grading (on-farm or at processing mill receipt) of dried stevia hay to determine quality grades as the basis for the payment to growers.

2. Undertaking of plant physiology and basic management practice studies to determine factors (including stresses) that influence or control flowering, glycoside accumulation, ratoon performance and total yield to optimise crop returns. These studies will include nutrient deficiency symptoms, irrigation and water tolerance and time of flowering and will identify criteria to use when selecting elite plants for seed production.

3. Further evaluation of weed control practices and herbicides to provide data for registration or permit-use of suitable chemicals to use with stevia.

4. Providing support for a limited number of farmers growing trial areas of stevia. This support will include provision of planting material and leaf analysis of plot samples. Supplementary Objectives (following approval by FSANZ)

5. Commencement of a plant variety selection program to provide varieties better suited to the various regions of potential production and to undertake larger scale regional trials covering mechanical practices such as height of cuttings, harvest intervals, irrigation frequency and oxygenation.

Background

There is a lot of scope for the use of the natural sweetener, stevia, in food products. During the conduct of this project we gained FSANZ approval for the use of the sweetener in foodstuffs in Australia and New Zealand. To capitalise upon this, there is a need to understand the effects of the Australian sub-tropical production environment on growth of stevia and to be able to quickly evaluate stevia leaves for the content of the sweetener.

Research

In the laboratory and field we evaluated the use of a non-destructive analysis of the sweetener, based on near infra red spectroscopy, backed up by improvements to a destructive analytical (hplc) technique. We also trialled herbicides in the field and studied the effects of nutrient deficiencies, pH, and day length on growth and sweetener content of stevia plants.

Outcomes

The NIRS evaluation technique was effective on dried leaf material, but not on fresh material. This assessment was strengthened by improvement to the laboratory analytical procedure. In the field, one herbicide, Prolan 500, was
superior in weed control with no negative effects on growth or sweetener content of stevia plants. An optimal growth pH just below neutrality and a full complement of nutrients favoured stevia growth and sweetener content. Flowering in the short days of the subtropics reduced yields, and we made some progress in selecting for later flowering. Numbers of potential growers were disappointingly low.

### Implications

The NIRS analysis is recommended for payment based upon quality of leaves and for screening of new lines for quality. Selection of new varieties more suited to the sub-tropics could be in place if industry backing is forthcoming.

### Publications

### Completed Projects - Miscellaneous

**PRJ-005130 Living wall and green roof plants for Australia**

| Start Date:  | 30/09/2010 |
| Finish Date: | 30/11/2011 |
| Researcher:  | Daryl Joyce |
| Organisation:  | The University of Queensland |
| Email: | d.joyce@uq.edu.au |

#### Objectives
- Review existing knowledge of plant selection and performance for extensive green roofs and living walls.
- Develop regionally specific plant species selection matrices for extensive green roofs and living walls in Australia.
- Use selection matrix criteria to generate lists of plant species, including ornamental and productive natives, putatively suited to regions and applications.
- Establish and evaluate plants on a proof-of-concept demonstration living wall and extensive green roof.
- Communicate outcomes with key stakeholders via an application focused plant improvement workshop.

#### Background
Green roofs and living walls in the built environment offer very significant triple bottom line benefits in terms of, for example, ameliorating urban heat island effects, reducing energy demands and attendant CO2 emissions (e.g. from air conditioning), improving the wellbeing and productivity of citizens, and providing habitat for micro- and macro-organisms. Although novel in Australia, green roofs and living walls are becoming increasingly widespread throughout Europe, Asia and North America. They represent a tangible opportunity for industry in Australia. However, plant products proven suitable for use in harsh Australian environments are needed. This is particularly so for outdoor green walls and extensive green roofs versus intensive roof gardens. In these two situations, areas are usually expansive, maintenance is ideally low and the growing medium (viz. water storage capacity) is typically shallow; for example, extensive green roofs on large factory roof tops. With careful planning and maintenance, green infrastructure can be a useful element of sustainable building design in this country.

#### Research
An overview of available literature, internet sources and industry/research contacts identified green roof and living wall plant selection criteria used overseas and critically analysed their relevance in the context of Australia’s climate. From this information selection matrices for two different green infrastructure applications of extensive green roofs and exterior living walls were generated and applied to a number of Australian native plant species to identify at least five species putatively suited to each application. Uniform plants of each species were propagated from stock plants already on hand or which had been sourced from native seed suppliers, native plant nurseries or private collections. Plants were transplanted as plugs or tubestock into the living wall and extensive green roof areas of two custom-built steel structures located at The University of Queensland’s Gatton Campus. An additional two identical structures without green infrastructure were also located at the trial site. Monthly evaluations of plant survival, plant growth as measured by dimensions (e.g. plant height and width, canopy area/density) and digital photography, plant development stages of flowering and seed set, pest and disease symptoms and canopy temperature were conducted. Internal roof and wall temperatures were monitored throughout the trial period for both the vegetated and un-vegetated (control treatment) structures. The experiment was designed and analysed in
consultation with a UQ biometrician. Outcomes were showcased at a workshop on green infrastructure species for Australia which included a forum to address the issues affecting growth of the industry.

Outcomes

Literature revealed that plant species for green infrastructure in Australia ideally need to withstand stresses of high temperature, wind and water deficit whilst providing good vegetation cover. Perennial species with mat-forming or dense clumping growth habits were considered best for long-term coverage. From these and other important traits, 16-point selection matrices were developed for extensive green roofs and external living walls. This allowed identification of six species putatively suited to extensive green roofs and seven species for green walls. In terms of actual performance, the native Myoporum parvifolium and Eremophila debilis, and the exotic Sedum sexangulare displayed the greatest survival and coverage on an extensive green roof. Growth rates of the three species were higher than expected with full coverage achieved 21 weeks after transplanting. For the green wall Bulbine vagans, Plectranthus parviflorus and Plectranthus argenteatus performed well in terms of growth and survival. However, the fast-growing B. vagans caused overcrowding of neighbouring plants. The workshop held towards the end of this project highlighted the need for ‘real’ local data to demonstrate the feasibility of green infrastructure to potential clients. In particular, industry would like to see quantitative data on the cooling effect of green roofs and walls being used as a basis for their more accurate inclusion in building sustainability incentive schemes such as the Green Building Council’s ‘Green Star’ rating. Additional findings of this report show that covering roofs and walls with greenery greatly reduces maximum temperatures of the internal roof / wall surface. The daily maximum temperature under an extensive green roof was up to 24°C lower than that for a conventional steel roof. For the green wall, temperature differences of up to 17°C were observed.

Implications

Until now there has been limited information available on the suitability of Australian native plant species for extensive green roofs and external green walls in Australia’s northern regions. This general limitation plus a specific lack of ‘local’ data to quantify the claimed benefits of green infrastructure have hindered its uptake in these regions. The research presented in this project report is an initial step forward. It has identified select Australian native plant species that can be successfully used for extensive green roofs and external living walls in a subtropical climate. It has also demonstrated that both applications can provide substantial thermal benefits, particularly during warmer months. An important issue is that industry specifications of green infrastructure in the subtropics should account for the consideration that a warmer climate is conducive to rapid plant growth, which may add to maintenance costs. This phenomenon may be countered by limiting the organic fraction of the growing medium and / or minimising the use of fertilisers and supplementary irrigation. Greater uptake of green infrastructure is likely to occur as the tangible benefits of green roofs and walls become increasingly well understood in Australian applications, including subtropical and tropical climate contexts.

Publications

RIRDC Publication 11/175
22 May 2012
### Completed Projects - Miscellaneous

**PRJ-007428 Minor use of chemicals – Insects and pathogens**

| Start Date: | 29/06/2011 |
| Finish Date: | 25/06/2012 |
| Researcher: | Ian Chivers |
| Organisation: | New Rural Industries Australia Limited |
| Email: | ian@nativeseeds.com.au |

#### Objectives

The aim of this project is to assist industry members of NRIA to obtain minor use permits for the use of chemicals to control insect pests and other pathogens and vectors in their respective industries by:

- Identifying and prioritizing their most important pest and disease problems.
- Identifying the most cost effective and practical chemical solutions for these problems.
- Determining what information is required to fulfill permit requirements, and obtaining that information.
- Submitting permit applications based on identified priorities and other practical considerations.
- Obtaining some permit approvals where attainable in the timeframe and detailing steps required to obtain permits for other, high-priority pests/diseases.

#### Background

This project examined the chemicals in use by new and emerging animal and plant industries for the control of diseases, insect pests and other conditions. Its aim was to collate information on industries’ need for permits, find points on commonality, and initiate the pursuit of permits where appropriate based on this data.

#### Research

Surveys and combined-industry meetings in Brisbane (olives, dates, pomegranates, kiwis, figs, green tea, longan, hazelnuts, rambutans, star fruit, jackfruit, mangosteen, durian, other tropical exotic fruits, tea tree, herbs, hemp, native grass seeds, lychees, okra and ginger were represented) and Sydney (dairy goats, mohair, angora, rabbits, alpacas, crocodiles, emus, ostriches and buffalo were represented) were used to derive a priority list for the pursuit of chemical registrations/permits that would achieve the greatest impact across the industries represented.

#### Outcomes

Based on priorities arising from surveys and meetings, cases were developed for granting permits, and in some cases applications for a Minor Use Permits were initiated. For the plant-based industries, applications for Minor Use permits will be made for Pest Oils, Bt, Potassium, Azoxystrobin, Bifenthrin, Copper, Imidacloprid and Mancozeb. For the animal-based industries applications will be made for 7-in-1 vaccines, Erysipelas vaccine, Selenium and Vitamins A,D and E.

#### Implications

Without this project, the industries concerned were unlikely to be able to pursue permits for their individual industry. If granted, the availability of Minor Use Permits will help to regularise the use of some chemicals within the new and emerging rural industries in Australia. This will enhance the development of those industries and provide them with more confidence about the appropriate use of chemicals as they are occasionally needed.
Completed Projects - Ginger

PRJ-005612 Controlling Pythium and associated pests in Ginger: Phase 1

Start Date: 01/04/2010
Finish Date: 30/08/2011
Researcher: Mike Smith
Organisation: The State Of Queensland Acting Through The Department of Employment, Economic Development and Innovation
Email: mike.smith@deedi.qld.gov.au

Objectives

- 50% adoption of practices to control Pythium rhizome rot and symphylids within 2 years after completion of research and dissemination of results.
- Increased production of ginger both from existing farms and through take up of new land in the Mary Valley (as above).

Background

The Australian ginger industry is valued at about A$20 million annually at the farm gate and is used for processing or is sold in an expanding fresh market. An additional A$60 million is generated by value-adding and collectively the ginger industry is a significant employer in Queensland’s Sunshine Coast region. An average of 8,000 tonnes of ginger rhizome is harvested annually from 560 ha. Pythium Soft Rot is regarded as one of the most destructive diseases of ginger worldwide and disease epidemics caused by Pythium myriotylum were first recorded in Australia during the wet summer of 2007/08. During the 09/10 season it was estimated that of the 3,000 tonne early harvest used for processing, 1500 tonnes was lost due to the effects of Pythium Soft Rot and symphylids, a soil-inhabiting arthropod that damages roots. Inability to meet market demand for ginger, both fresh and processed, was a real concern. The industry regarded the need for research into pathogen control as a critical step to the industry’s survival. The 45 members of the Australian Ginger Growers’ Association agreed to introduce a voluntary levy system which will generate resources to support continuing research and will contribute substantially towards consolidating the industry. The levy system was formally introduced in April 2011 and will be managed for industry by the RIRDC. The current project was developed to better understand the threat posed by Pythium myriotylum and symphylids to the ginger industry and to identify measures for their control.

Research & Outcomes

The study has clearly demonstrated that the pathogen capable of causing Pythium Soft Rot in ginger is spread in contaminated soil and water. Furthermore, the study found that infected rhizomes and sections of the rhizome used for planting material (i.e. ‘seed’) can also spread the disease. Eight agricultural chemicals, known to have some efficacy in controlling Pythium in other crops, were used as a seed dipping treatment and compared with carbendazim, the industry standard. A metalaxyl/phosphonate treatment and a Proplant® treatment showed the most promise in controlling Pythium Soft Rot in pot trials however they failed to achieve any practical levels of control in the field. Pre-plant applications of metalaxyl and post-plant foliar applications of phosphonate, metalaxyl/mancozeb and strobilurin mixes also failed to achieve significant levels of control. Likewise granular metalaxyl formulations were ineffective. Studies with common rotation crops/cultivars used in the ginger industry and including oats, sorghum, corn, lab lab, brassicas and grass mixes, all failed to show disease symptoms in pot trials when inoculated with the pathogen. Furthermore the pathogen could not be isolated from the roots. The incidence of Pythium Soft Rot was also significantly lower in a ginger crop that had been fallowed for over a year. Confidor® Guard, Regent® and Talstar®, when incorporated into the bed prior to planting and followed by two post-plant applications prior to early harvest, significantly lowered levels of root damage...
caused by symphyldids, and consequently, higher yields were achieved compared to the untreated controls. Only the product containing chlorpyrifos failed to control symphylid damage to ginger roots.

Implications

On-farm quarantine measures are needed to keep the disease out, if the farm is currently free from disease, while stringent quarantine and hygiene measures need to be in place to prevent its spread if the farm is currently infected. The fact that Pythium myriotylum is spread in seed that can be used as planting material provides further justification and impetus for the need for a Clean Seed Scheme for the ginger industry. Chemical control options have not proven successful possibly due to the nature of the ginger’s growth during the season. For instance, the plant is continually forming new, immature rhizomes and shoots during the warm, wet summer months when the crop is most susceptible to attack from Pythium myriotylum and when the pathogen is most active. In order to relieve disease pressure on affected farms, the land should be spelled for as long as possible or at least until we have more information on the viability of the resting oospores in the production region’s soils and climate. In the interim, alternative crops or pastures that will not allow the pathogen to multiply need to be grown as an alternative to ginger. In contrast to the chemical control strategies used for Pythium myriotylum, the control of symphyldids was achieved with either Confidor® Guard at 3 L/ha pre-plant and 1.5 L/ha post-plant, Regent® at 500 ml/ha pre-plant and 250 ml/ha post-plant, and Talstar® at 2 L/ha pre-plant and 500 ml/ha post-plant.

Publications


RIRDC Publication 11/128
11 Nov 2011

RIRDC Fact Sheet 112/003
15 Feb 2012
## Completed Projects - Ginger

### PRJ-008416 Improved clean seed distribution systems for the Australian Ginger Industry

| Start Date: | 23/03/2012 |
| Finish Date: | 30/06/2012 |
| Researcher: | David Hall |
| Organisation: | Hallways Consulting |
| Email: | david.hall121@gmail.com |

**Objectives**

Review, analyse and report on the immediate and longer-term effects of the current system of propagating, handling and distributing clean seed rhizomes for the Australian Ginger Industry.

The analysis will focus on the issues of access and distribution, to ensure systems are equitable for all Australian ginger growers. Options for future improvements to the system will be identified.

**Background**

Pythium myriotylum became a major disease for the Australian Ginger industry in the 2007-08 season. The supply of clean seed is essential for the establishment and re-establishment of disease-free and dynamically-growing ginger crops. This report details a short study undertaken at the request of the Ginger R&D Advisory Committee to review policies and processes around the provision of clean seed within the industry.

**Research**

This study looked at the issues affecting the handling and distribution of clean seed within the Australian ginger industry, with emphasis on the problems that have arisen since Pythium started to affect the industry.

**Outcomes**

Options for the industry are provided for the consideration of industry and policy-makers.

**Implications**

Some suggestions are provided, which, if implemented, should increase the supply of clean seed and, in turn, allow an increase in production of Australian ginger.

**Publications**

RIRDC Publication 12/046

30 May 2012
## Research in Progress - Native Foods

**PRJ-005135 Changes in quality (bioactivity) of native foods during storage**

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<tr>
<td>Finish Date:</td>
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<tr>
<td>Researcher:</td>
<td>Yasmina Sultanbawa</td>
</tr>
<tr>
<td>Organisation:</td>
<td>The University of Queensland</td>
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<td>Email:</td>
<td><a href="mailto:Yasmina.Sultanbawa@dpi.qld.gov.au">Yasmina.Sultanbawa@dpi.qld.gov.au</a></td>
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### Objectives

The objectives of this study are to:

- Investigate the current handling practices, processing, packaging and storage of whole and processed native foods.
- Conduct a storage trial with the current practices of the industry to determine losses in quality and bioactivity.
- Develop and evaluate novel approaches for assuring quality (retention and stability of bioactives) in native foods during value addition.
- Study storage stability of bioactivity (antioxidant, antimicrobial and flavour profiles) and identified markers to ensure a product with consistent quality.
- Develop protocols with optimised conditions for handling, processing, packaging and storage.

### Current Progress

Large scale storage trials of milled and dried lemon and anise myrtle leaves and Tasmannia pepper leaf (TPL) whole and milled commenced in February/April 2012. High barrier packaging material which was effective in reducing the loss of volatiles was used. The storage trial is in progress and changes in volatiles, non-volatiles, antimicrobial activity and colour have been monitored. Residue samples after extraction of the essential oils from lemon and anise myrtle and TPL have been sourced and are being evaluated for bioactives.

Whole and pureed samples of Kakadu plum were used for the storage study. The whole fresh Kakadu plums were from this years harvest and were from the Northern Territory. These samples were blast frozen and vacuum packed and changes in vitamin C, egalic acid and antimicrobial activity monitored.

Further evaluation of Davidson plum as a natural antimicrobial is been assessed. Some of the research findings on the potential of using Davidson and Kakadu plums as natural antimicrobials were presented at the Dubai International Food Safety Conference – 21-23 February 2012.

Posters titled: Antibacterial activity of selected Australian native fruit extracts and Shelf life extension of comminuted meat using natural antimicrobials.
Research in Progress - Native Foods

PRJ-005925 Davidsonia domestication: productivity constraints in Far North Queensland

Start Date: 29/07/2011
Finish Date: 30/05/2013
Researcher: Tony Page
Organisation: James Cook University
Email: tony.page@jcu.edu.au

Objectives

• To identify factors responsible for year-to-year, orchard-to-orchard, and between-tree variation in fruit productivity in orchards of *Davidsonia pruriens*.

• To characterize patterns of natural variation in *D. pruriens* as a base for future domestication work.

• To characterize the mating system of *D. pruriens*.

• To facilitate domestication by developing vegetative propagation techniques and establishing a clonal test.

Current Progress

In this reporting period we have undertaken work towards all objective areas. A report has been completed which outlines the current state of grower knowledge for Davidsonia production. We recorded a fruit to flower ratio of 0.0013. The fruit production rate of the three trees that produced fruit was around 1.1% with one tree attaining 2.5%. While the trees produce a mass of flower buds, they open gradually over a period of months. This type of flowering phenology may be described as opportunistic where a small number of flowers are available for pollination at any given time and only set fruit when the environmental conditions are conducive for pollination and/or fruit set.

Our observation of pollen that float on air-currents and the obvious lack of any insects tending flowers during all experiments, lead us to consider that wind pollination may be possible for *D. pruriens*. From controlled pollination work we found that pollination may not be limiting factor for fruit set in these orchards. A total of 5 *D. pruriens* populations have been visited during the reporting period, all consisting of the ‘hairy’ type.

We propose further exploration of populations in an attempt to locate the ‘smooth’ type before undertaking detailed morphometric studies of the ‘hairy/typical’ populations.

We have undertaken both cutting and marcot propagation during the past few months. Cutting success (11.7%) while low can allow us to establish hedge plants for further cutting propagation towards establishing the clonal test.

A total of 16 marcots were set at the Sunset Ridge orchard in April and will be assessed in September 2012.

Grafting will be undertaken in October 2012.
Research in Progress - Culinary Herbs, Spices & Beverages

PRJ-000420 Commercialising cocoa growing in north Queensland

Start Date: 01/07/2007
Finish Date: 30/04/2012
Researcher: Yan Diczbalis
Organisation: The State of Queensland acting through the Department of Agriculture, Fisheries and Forestry
Email: yan.diczbalis@dpi.qld.gov.au

Objectives

This Project is focused on supporting development of a new commercial cocoa industry based in North Queensland. The project will have 3 main components:

- Facilitate, support and monitor Cadbury Schweppes (now Kraft) linked pilot commercial cocoa plantings.
- General industry development activities/support including publication of an Australian Cocoa Growing Guide.
- Support to non Kraft-linked growers including Cocoa Australia linked growers and to CA management/proprietors.

In association with component i. another objective will be to further evaluate existing and new planting material (yield and general performance) in commercial plantings and test the commercial viability for production of ‘commodity’ cocoa.

The overall objective from all activities will be to reduce risks to participants in the emergent industry and increase the likelihood of a viable cocoa industry becoming established in North Queensland whether for commodity or ‘niche’ markets.

Furthermore, performance of the project will provide on-going engagement with the emergent industry. This will result in an awareness of technical and structural issues which arise so that they can be addressed or strategies developed.

Current Progress

Tree recovery in the Innisfail region, following cyclone Yasi has been poor. Only one farmer has committed to replanting. New plantings are occurring under bananas and have progressed well. The farmer now has his chocolate making machinery in place and with assistance from DEEDI (QDAFF) has received accreditation for a food processing facility by the local council health department. Trial chocolate making has commenced on beans picked, fermented and dried pre Cyclone Yasi.

Daintree Estates (reconfiguration of Cocoa Australia) has recommenced discussions with DEEDI (now QDAFF). The group has requested assistance with agronomic management and fermentation techniques and monitoring. A meeting and farm inspections were held on the 8 March 2012 with four growers supplying pods. Farm visits also occurred on the 21 March 2012.

Planning has commenced for fermentation monitoring, when the group commence harvesting, to examine the microbiological and flavour differences. Fermentation techniques will include; traditional box, rotating barrel and tray systems. The property in Mossman with the cocoa pod borer outbreak is being managed by Biosecurity Queensland. The original trial orchard has been heavily pruned with full pod removal and including regular application of insecticides. Under tree leaf litter was also removed to assist in breaking the insect breeding cycle. No pod borers have been captured in pheromone traps since the control measures have been completed.
## Research in Progress - Culinary Herbs, Spices & Beverages

**PRJ-005474 Australian saffron: Commercialisation of drying technology and aroma analysis**

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<tr>
<td>Finish Date:</td>
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<tr>
<td>Researcher:</td>
<td>Robert Menary</td>
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<td>Organisation:</td>
<td>University of Tasmania</td>
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<tr>
<td>Email:</td>
<td><a href="mailto:r.menary@utas.edu.au">r.menary@utas.edu.au</a></td>
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### Objectives

The overall objective of this project is to facilitate the consistent production of premium quality saffron spice by the Australian Saffron Industry. This may be achieved through the following aims:

- Implementation of recommended commercial drying conditions to optimise the colour and aroma strength of the spice.
- To chemically characterise saffron aroma composition and formation processes (for both desired and “off” notes) for optimisation of aroma quality and the differentiation of Australian product from imported spice.

Specific objectives will include:

- The design of a relatively inexpensive drying apparatus for achieving optimum saffron aroma and colour strength. This device is required to maintain precise temperature and humidity and with the capacity to process large batches of stigmas. Such a device should be as “user friendly” as possible.
- The commercial scale trial of prototype equipment in collaboration with the Industry partners and their contracted growers, followed by modification where necessary.
- Production of a clear user manual for the device and method.
- Demonstration of recommended drying method (using final model of device) to growers to encourage uptake of technology.
- Characterisation of saffron aroma notes through organoleptic and chemical analysis.

### Current Progress

The analysis of trial drying runs using the prototype apparatus during the 2011 harvest showed that particular modifications were required to realise the full potential for saffron aroma development during spice production. Consultation with the Project Engineering Advisor led to the recommendation for modification of the current prototype rather than construction of a new one. The specific modifications were carried out in November/December 2011 and the device tested for temperature/humidity control and drying efficacy using substitute plant tissue in February/March 2012. These tests demonstrated that improved humidity control was now possible. Trials using actual saffron stigmas have just begun with the onset of the 2012 harvest through April/May 2012.
# Research in Progress - Culinary Herbs, Spices & Beverages

<table>
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<tr>
<th>PRJ-005836 The Australian Green Tea Newsletter</th>
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<tr>
<td><strong>Start Date:</strong> 30/06/2009</td>
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<td><strong>Finish Date:</strong> 07/03/2015</td>
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<tr>
<td><strong>Researcher:</strong> Gordon Brown</td>
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<td><strong>Organisation:</strong> Scientific Horticulture</td>
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<td><strong>Email:</strong> <a href="mailto:Gordon@scientifichorticulture.com.au">Gordon@scientifichorticulture.com.au</a></td>
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## Objectives

The objective of the forum / newsletter is to improve communication within the industry to aid in:

- Awareness of activities in different regions.
- Articles on problems being encountered and potential solutions in different regions.
- Improving the knowledge of tea physiology, production, processing and marketing with industry members.
- Industry information dissemination such as RIRDC activities and reports.
- An opportunity for industry participants to raise questions and seek input from others on issues of concern.
- Encouragement and co-ordination of industry development such as the formation of the industry association.

## Current Progress

Milestone Task: Newsletters written and mounted on wiki, Documents of interest mounted, Industry members invited to participate.

Performance Indicators: 2 newsletters, Industry invitations, this report.

Project performance. A private wiki developed which requires a password for members to view and add to the information. A visitors username and password was set, www.wikispaces.com, login, username and password, GTvisitor.

Two articles on tea fertilizer requirements were mounted on the site in October 2011. A further article on the mechanism of fairtrade certification and its implications for Australian tea production was added to the site in April 2011.

A review of the scientific publications on tea research for Oct,Nov,Dec 2011 was added in December. This was repeated for Jan,Feb,March 2012.

The report of the green tea priority setting workshop, 2010, has been added in November 2011.

Industry members were asked to join in December 2011. Two members joined at this time. It was thought that the poor response was due to the invitation being treated as spam.

In 2012 the new articles and invitations to join were included in an individualised email. It would appear as though developing and maintaining interest in a ‘social’ media style approach for the industry will need special attention.
Research in Progress - Culinary Herbs, Spices & Beverages

PRJ-006673 Identification of desirable coffee secondary metabolites

Start Date: 26/06/2011
Finish Date: 07/03/2015
Researcher: Myrna Deseo
Organisation: Southern Cross University
Email: myrna.deseo@scu.edu.au

Objectives

The overall objective of this research is to develop an objective tool to measure coffee quality using coffee metabolites as quality parameters. This study will provide baseline data to understand the chemical variability of Australian and overseas coffees and how these variations affect cupping quality from the cherries to the cup. It will identify metabolites that can be used as marker compounds and associate these metabolites with quality attributes. Likewise, it will identify any distinguishing chemical profile of the Australian coffee that can be associated with cupping quality.

Current Progress

A total of 45 DGB samples had been collected through the help of the project collaborators: Australian Subtropical Coffee Association, James Drinnan and David Peasley. The method for the quantitative analysis of caffeine had been refined and optimised. The method was tested on 6 DGB samples and corresponding roasted beans. Significant differences in caffeine content were observed. Australian beans showed lower caffeine content than the imported bean for both DGB and roasted beans. Caffeine content was observed to be higher in the roasted beans than the corresponding DGB’s. Moisture content determination is currently being carried out to determine if this difference could be due to differences in moisture content.

Fatty acid analysis showed that the major component in both DGB and roasted beans are linoleic and palmitic acids. There was no distinct difference in the fatty acid composition of DGB and roasted beans but further assessment will be carried out to confirm this observation.

Preparation for the cupping assessment of DGB samples (Milestone 1) is underway, to be carried out by the Melbourne group led by Mark Ryan (Eureka Coffee). A meeting was held with the group on 3 May 2012 in Melbourne to discuss the logistics of this activity. Since the project staff will be engaging with the persons who will carry out the cupping and associated activities, an ethics application had been submitted through SCU’s Human Research Ethics Committee and had been approved (ECN-12-052 dated 6 March 2012).
Research in Progress - Fruit, Vegetables & Nuts

PRJ-003302 Improving seed sprout food safety: a farm to retail assessment

| Start Date:       | 15/06/2009  |
| Finish Date:      | 30/07/2012  |
| Researcher:       | Andreas Kiermeier |
| Organisation:     | The Minister for Agriculture, Food and Fisheries acting through South Australian Research & Development Institute |
| Email:            | andreas.kiermeier@sa.gov.au |

**Objectives**
The objective of this project is to improve the food safety of alfalfa seed sprouts available for sale to consumers and to facilitate the development of the seed sprout industry.

**Current Progress**
Stage 3 "Decontamination trials" of this project has not been completed. Experiments for Calcium hypochlorite, peracetic acid and heat treatment have been undertaken to assess effectiveness on E. coli O157 and Salmonella. The impact on germination rates has also been assessed.

A report of the findings has been sent to members of the steering committee on 23 March 2012. A steering committee teleconference was held on 4 April 2012 to discuss the findings and plan the remainder of the work to be undertaken as part of this project.

A project update is currently being drafted and will be submitted to RIRDC prior to release to project stakeholders. It is also envisaged that this update is provided to ISC via the relevant Implementation Working Group.

Additional decontamination work has been undertaken with peracetic acid. In this work bicarb of soda was used to neutralise the peracetic acid with the aim to improve germination percentages. So far no improvements in germination percentage have resulted.

The final seed cleaning trial is being undertaken, using the same seed cleaner as previous. This change has been made as the seed cleaner in Keith has been uncontactable.
# Research in Progress - Fruit, Vegetables & Nuts

## PRJ-005083 Pilot production and sales of red bayberry in Australia

| Start Date: | 30/11/2010 |
| Finish Date: | 15/05/2014 |
| Researcher: | Daryl Joyce |
| Organisation: | The University of Queensland |
| Email: | d.joyce@uq.edu.au |

### Objectives
- Selection of additional superior Australian red bayberry clones for desirable plant and fruit quality characteristics.
- IP protection (e.g. PBR or trade marking) of selected red bayberry clones for commercialisation.
- Pilot scale propagation of selected superior red bayberry clones for commercial trialling in Queensland and Northern New South Wales.
- Pilot scale commercial scale trial plantings on participating grower’s properties of red bayberry trees for fruit production.
- Refinement of agronomic (e.g. pollination, pruning and thinning) practices for red bayberry trees.
- Protocols for post-production red bayberry fruit packaging, handling and marketing.
- Test marketing of fruit from selected red bayberry clones.

### Current Progress
Propagation experiments conducted at UQG have highlighted the importance of genotype, juvenility, season and applied auxin concentration in successful cutting propagation of Red Bayberry. This has led to a steady increase in plant numbers, with >140 potted plants of the elite N1 and N2 series genotypes currently being maintained at UQG.

Regular contact with trial growers has been maintained via telephone and emails. Early reports on the progress of the plantings have been mixed. Trees are growing well at the Atherton (Qld), Yeppoon (Qld) and Corindi (NSW) trial sites. However, major losses have been reported for the Wamuran (Qld) and Silvan (Vic) sites. Replacement trees for the Silvan site were supplied in April. Concern regarding the persistence of a pre-emergent herbicide in the soil at Wamuran has delayed re-planting at this site.

Industry partner Birdwood Nursery recently determined to leave the project. New partnerships are currently being formed with Narromine Transplants to ensure commercial propagation activity continues as planned. A partnership is also being developed with CleanGrow, a commercial tissue culture operation. Potted plants of N1MR06, N1MR07 and N1MR09 have been supplied with a view to establish in vitro propagation.
Research in Progress - Fruit, Vegetables & Nuts

PRJ-005304 Development of Chinese Date-Jujube Industry

Start Date: 30/11/2010
Finish Date: 30/11/2013
Researcher: Rachelle Johnstone
Organisation: Department of Agriculture and Food
Email: rachelle.crawford@agric.wa.gov.au

Objectives
The proposed two year project is designed to support the developing industry by carrying out R&D in all aspect of the market development, integrate production, grading, packing, marketing of Jujube.

The project will be carried out in Western Australia with linkages developed nationally with interested parties.

Current Progress
A literature review of Chinese jujube and economic analysis of WA production have been completed.

An awareness campaign was run during the 2012 season which generated good interest. This campaign used media releases to print and radio. A Farmnote about the crop was also produced and is available on our website. The West Australian newspaper featured an article and photograph plus comment by its food critic. Our information was also used by rural newspapers (The Countryman, Farm Weekly) and local publications.

The campaign was successful in raising awareness with the general public and potential growers from across WA, eastern states and overseas. It also encouraged existing growers to be part of a ‘jujube grower group’ which will meet in July.

Monitoring of trees has continued at the three orchard demonstration sites (Gidgegannup, York and Bindoon) and will continue next season. Information is being added to the ‘Field Manual’ as data is collected and from ongoing desktop research.

A desktop analysis of the South East Asian jujube market is in progress.

Under alternative funding, but aligned to this project, Dr Fucheng Shan and an industry representative attended the Second International Jujube Symposium in China in September 2011. This increased knowledge of the latest research and development and helped develop linkages with Chinese researchers. A further activity will be the visit of Chinese expert Professor Liu from the Hebei Agricultural University to WA in March 2013.
Research in Progress - Fruit, Vegetables & Nuts

PRJ-005700 Water use and the irrigation requirements of hazelnuts in Australia

| Start Date: | 01/03/2011 |
| Finish Date: | 17/05/2015 |
| Researcher: | Yann Guisard |
| Organisation: | Charles Sturt University |
| Email: | yguisard@csu.edu.au |

**Objectives**

- To assess the effects of irrigation applied during some key developmental phases of nut growth and development.
- To assess the effects of volume of delivery of drip irrigation emitters on the volume of wetted soil and its influence on growth and production.
- To utilise moisture sensors to monitor soil moisture levels and root activity in a developing hazelnut orchard.
- To compare a range of irrigation scheduling techniques, including high and low cost soil moisture monitoring equipment as well as evapotranspiration methodologies, and report to growers the most cost effective technique.

**Current Progress**

There has been no work done on this project since the last report. This is due to the fact that the Investigator and owner of the research site suffered a broken back. As a result, the overall data collection was not captured since last report. A new timeline for this project was established and will collect data from August 2012. Baseline data in August will give an indication of the dormancy soil water capacity before and after killing the grass between trees. Probes will be installed in July 2012 (confirmed with contractor) and the irrigation system will be modified as per project design by the end of August. Soil water relations will be measured at the time of installation of the probes. Hazelnut trees will leaf in September 2012 and, in view of current practices and weather forecasts, no irrigation will be applied until (probably) November 2012. Physical tree measurements will be carried out in September 2012 and physiological leaf water potential fortnightly then on.
Research in Progress - Fruit, Vegetables & Nuts

PRJ-006535 Linking rambutan phenology and key economic germplasm for improved production

Start Date: 19/05/2011
Finish Date: 15/11/2014
Researcher: Mark Hoult
Organisation: Northern Territory of Australia represented by the Department of Resources
Email: Mark.Hoult@nt.gov.au

Objectives

- Identify, introduce and secure all Australian Nephelium germplasm at a central repository. Research and industry knowledge and key attributes on each accession will be reviewed and documented via a germplasm database produced in year 1.
- Identify potential “male” pollinator seedlings/selections from industry orchards and Departmental seedling blocks. Field establish them for early appraisal as potential early, mid and late flowering pollinators in the first and second flowering season of the project.
- Develop improved propagation methods with emphasis on clonal vegetative cuttings and early graft compatibility for key rambutan clones and Nephelium species during the first and second monsoonal seasons.

By year three, field establish unique stock scion combinations in a:
- Preliminary rootstock evaluation trial
- Nephelium germplasm repository
- On-farm screening plots of unique stock scion combinations and novel high density clonal orchard systems.

- Strengthen research and industry networks with Australian and international Nephelium collections and experts over the lifetime of the project.

Current Progress

Information
- Draft literature review completed
- First editing of “Selected Rambutan Cultivars in the NT” Lim & Landrigan
- Collation of all available germplasm information achieved

Propagation
- 300 open-pollinated seedlings from 7 maternal cultivars established
- Seed storage by % germination study completed
- Marcotts of 3 species successfully recovered
- First vegetative cutting trial implemented with germplasm x auxin type and rate x cutting type x cutting media type treatments overlayed. Over 350 cuttings established in this preliminary investigation

Infrastructure
- Old mist house refurbished at Berrimah research Farm (BRF) by Northern Territory Department of Resources
- New fog facility built at BRF by Northern Territory Department of Resources. This is a critical facility as the project advances and was funded by NT government with operational costs in part from RIRDC project funds
- New protected netted block at Coastal Plains Research Station in preparation for rootstock and germplasm plantings- monsoonal season 2012/13.
Research in Progress - Fruit, Vegetables & Nuts

PRJ-007392 Developing an Australian Date Industry

Start Date: 01/06/2011
Finish Date: 30/11/2013
Researcher: Anita Reilly
Organisation: Gurra Downs Date Company Pty Ltd
Email: reilly@gurradowns.com.au

Objectives

- To ensure the Australian date industry can advance with best possible genetic material (yield, agronomic suitability, marketability) to provide Australian growers with a competitive advantage to that of northern hemisphere producers.
- To create a date palm headquarters/repository where the wider community can view all aspects of date production.
- To further promote the Australian date industry, network with existing growers and provide training in various aspects of date palm husbandry.

Current Progress

We (Dave & Anita) continue to study for a Certificate in Training & Assessment to gain accreditation for training other date growers in the various aspects of date husbandry. We have dedicated the first 7 months of 2012 to overseas study tours - to learn date palm husbandry techniques and collect information and photos for inclusion in the grower’s manual. We have also forged important networks with USA date growers in Arizona and California. We have continued education and extension activities by hosting property visits from prospective growers and providing local and international presentations. We continue to network with other growers around Australia and have begun training local growers in the art of offshoot removal on their home properties. Pruning and preparation for offshoot removal has continued on the home property under supervision from son Shaun Reilly. These offshoots when removed will be relocated to the Brauer block. The tissue cultured ‘new’ varieties continue their nursery process in preparation for planting out. Gurra Downs has recently been advised of a successful Caring For Our Country funding bid. This additional funding will enable the Brauer Block project to proceed full steam ahead on Dave’s arrival home from overseas in July.
## Research in Progress - Fruit, Vegetables & Nuts

### PRJ-008146 Value adding options for tropical fruit - using jackfruit as a case study

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<thead>
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<tbody>
<tr>
<td>Finish Date:</td>
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</tr>
<tr>
<td>Researcher:</td>
<td>Adrian Best</td>
</tr>
<tr>
<td>Organisation:</td>
<td>Synerge Pty Ltd</td>
</tr>
<tr>
<td>Email:</td>
<td><a href="mailto:bestadrian@mac.com">bestadrian@mac.com</a></td>
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</table>

### Objectives

The aim of project is to break down and analyse value adding and market opportunities for tropical fruits using Jackfruit as a case study. While jackfruit will be the focus of this study, readers and other industry groups will be able to apply aspects to other tropical fruits.

Jackfruit is one of the hardest cases to undertake to promote to the Australian market. Other fruits by comparison should be a lot easier in comparison for other industry grower groups.

### Current Progress

The original intention of this project was for testing by QDAFF/DEEDI to provide testing facilities/resources for an analysis of a range of components of the Jackfruit. Other priorities in the wake of floods/cyclones have led to QDAFF’s facilities and resources being unavailable for this study. Sufficient information from literature and food service contacts was obtained to be able to produce a good analysis of the possibilities/economics for jackfruit, without undergoing further analysis. One of the more important tests - that of juicing/analysis NT-sourced Jackfruit (as they use a much less crisp/juicy variety) and has identified that NT fruit may indeed not be suitable for juicing. Opportunities for developing a new model for grower business model are critical to support the growth and diversification of the industry moving forward. To achieve this requires the engagement of training and financial organisation and coordination of growers into a better-informed and resourced organisation.
## Research in Progress - Grains & Pulses

**PRJ-004225 Quinoa as a new crop in Australia**

<table>
<thead>
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<tbody>
<tr>
<td>Finish Date:</td>
<td>15/05/2013</td>
</tr>
<tr>
<td>Researcher:</td>
<td>Jon Clements</td>
</tr>
<tr>
<td>Organisation:</td>
<td>University of Western Australia</td>
</tr>
<tr>
<td>Email:</td>
<td><a href="mailto:clem@cyllene.uwa.edu.au">clem@cyllene.uwa.edu.au</a></td>
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</tbody>
</table>

### Objectives

- To determine the most likely regions suited to quinoa growing across Australia.
- To generate interest and exposure of quinoa to growers in Australia.
- To explore market potential through project involvement and feedback with a commercial partner.
- To select quinoa germplasm accessions that perform well across all regions or lines with specific adaptation via time of sowing field assessment.
- To select quinoa germplasm that are suited to either Mediterranean or cooler climate growing conditions and with winter versus summer growth adaptation. To determine the typical protein content of quinoa grown in Australia as derived from contrasting environments.
- To select lines that have low saponin that would either be suited to cultivar status or could be used for future breeding purposes.

### Current Progress

Plant establishment was successful at one of the 5 field sites in 2011 and this demonstrated the sensitivity of the quinoa crop to seeding depth interacting with soil moisture. If the major issues of seeding depth and correct genetic material can be improved, quinoa is expected to yield well under a wide range of environments. Several genotypes performed well with respect to biomass production, however a herbicide application appeared to have a detrimental effect on flower bud fertility and therefore almost no yield was achieved at the site for all but one genotype planted as a bulk strip plot. This genotype yielded relatively well at Narrogin and a subselection has been made from this genetic material. Due to the poor establishment in 2011, we will need to test these genotypes in further trials during 2012 where the knowledge gained so far with respect to best seeding and management will allow us to produce more conclusive results regarding best lines for recommendation and provision to interested growers. Our aim is to sow trials at several sites in WA and one site each in Tasmania (winter and if possible, summer site), South Australia, Victoria and NSW during 2012 in discussion with RIRDC.
Research in Progress - Grains & Pulses

PRJ-006615 Commercialisation of elite lines of Microlaena stipoides as a perennial grain

| Start Date: | 19/05/2011 |
| Finish Date: | 30/07/2013 |
| Researcher: | Frances Shapter |
| Organisation: | Southern Cross University |
| Email: | fshapter@scu.edu.au |

**Objectives**

This project will evaluate the ease of establishment of the various breeding lines and their persistence under the conditions of a coffee plantation in the first instance.

This project will also conduct these evaluations in agroforestry. Assessments will be made of the establishment and persistence, the grain yield, and the ease of harvest of the various breeding lines. Using these data it will be possible to develop economic models for how this crop may be incorporated into these agricultural systems.

The overarching objective of this research is to undertake rigorous “on-farm” case studies for the commercialisation of Microlaena stipoides as an environmentally sustainable, water and nutrient efficient grain crop which increases the productivity of agricultural land and provides a new avenue for agricultural diversification.

**Current Progress**

1. Evaluation of Primary Trial Final Northern NSW trial site evaluation (03/05/12) confirmed all broadcast plots failed to establish. Firth et al, 2002 showed that this establishment methodology has been successful previously (http://www.tropicalgrasslands.asn.au/Tropical%20Grasslands%20Journal%20archive/PDFs/Vol_36_2002/Vol_36_01_02_pp01_12.pdf).

Our lack of establishment was primarily due to irregular and insufficient rainfall at planting. Future recommendations for establishing Microlaena in Northern NSW/Qld would include availability of irrigation for the first 8-10 weeks or use of mulching product to retain surface moisture.

Mutant lines transplanted into this site have thrived, with multiple individual harvests undertaken. Several lines were able to out-compete weed encroachment and develop dense, rapidly spreading culms. This suggests that when the issues surrounding establishment are overcome, some lines of Microlaena are well suited to production in this region. Surviving plants have been transplanted out of this site and re-established in SE Qld, with the most promising plants split and established as a separate population, for seed multiplication and evaluation in Melbourne.

2. Establishment of secondary trial Future broadcast seed trials will be conducted in Victoria, to facilitate establishment and align with seasonal rainfall patterns. A suitable second site has been identified within the Lighthouse Olive plantation at Marcus Oldham Agricultural College.

Organisation for the June planting has begun. Employment of a part-time field technician and an associated reduction in the CI salary has been approved to facilitate this change.
### Research in Progress - Cultural and World Foods

**PRJ-003974 Investigation of factors to improve black truffle yield**

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<th>Start Date:</th>
<th>30/05/2009</th>
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<tbody>
<tr>
<td>Finish Date:</td>
<td>30/04/2013</td>
</tr>
<tr>
<td>Researcher:</td>
<td>Celeste Linde</td>
</tr>
<tr>
<td>Organisation:</td>
<td>Australian National University</td>
</tr>
<tr>
<td>Email:</td>
<td><a href="mailto:celeste.linde@anu.edu.au">celeste.linde@anu.edu.au</a></td>
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</table>

#### Objectives

To investigate the genetics of truffle strains used in Australia, in an attempt to identify a possible cause for low truffle yields in Australian truffieres. Truffle samples will be collected from trufferies in the ACT, NSW and WA as well as truffle nurseries in Tasmania and WA to assess truffle genetic diversity and truffle mating type distribution.

**Assess genetic variability and mating type distribution of Tuber melanosporum.**

Low genetic diversity in truffles would limit their capability to form productive associations with a wide range of tree species and genotypes as well as with site interactions. The genetic diversity of Périgord truffles in Australia will be determined from truffle nurseries as they are the source of truffles in the rest of the country. The genetic diversity of Australian truffles will be compared to truffles in eg France (published data) to assess whether the Australian truffles are possibly suffering from a large genetic bottleneck impairing its ability to produce large truffle yields.

Uneven distribution of mating types of truffles will result in the truffle not being able to find a sexual partner to interact with and produce truffles. Now that we will have genetic markers available, we can test for the first time what the quality of truffle inoculum is on trees produced, which provides a major step forward in excelling the truffle industry in Australia.

**Determine host-genotype-interactions between truffle and host genotypes.**

Most fungi and their trees interact in a specific way resulting in various levels of subsequent fungus growth, depending on the specific interaction. It is very likely that specific interactions also exist in black truffles and their tree hosts.

#### Current Progress

As per recommendation to the truffle industry resulting from the work conducted in this project, the Australian Truffle Association is willing to investigate a Tree Certification Scheme to improve the quality of truffle-inoculated nursery seedlings and quality of inoculum. After investigating suitable schemes in Europe, it was decided to further investigate a tree evaluation scheme developed by Dr. Christine Fischer in Spain. I (together with an ATGA representative) spend a week with Christine in Lleida, Spain, learning the Plant Evaluation Scheme, which, with a few adaptations, could be applied seemlessly to the Australian system. However, Australian nurseries seem reluctant to take this up. The only way individual growers will know what they buy appear to be for them to get the trees analysed prior to purchase. This will be further discussed at the Truffle meeting in August. Mating types: Testing of mature trees correlate well with production, ie producing trees have both mating types. However, both mating types can also be found on non-producing trees, indicating another factor involved in production.
**Research in Progress - Cultural and World Foods**

**PRJ-005070 Development of a nano-sensor for volatile analysis of Australian Black Truffles**

<table>
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<th>Start Date:</th>
<th>01/06/2010</th>
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<tbody>
<tr>
<td>Finish Date:</td>
<td>30/01/2014</td>
</tr>
<tr>
<td>Researcher:</td>
<td>Garry Lee</td>
</tr>
<tr>
<td>Organisation:</td>
<td>TSW Analytical</td>
</tr>
<tr>
<td>Email:</td>
<td><a href="mailto:garry.lee@uwa.edu.au">garry.lee@uwa.edu.au</a></td>
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**Objectives**
The primary objective of this study is to define the aroma profile (measureable volatiles) of a good Australian black truffle (*Tuber melanosporum*). Secondary objectives are to:

- Define the aroma profile (measureable volatiles of a rotten truffle).
- Investigate and quantify the differences in the volatile profile of Australian Black truffles grown in different regions.
- Investigate the volatile profile as it changes over time.
- Conduct a preliminary study of differences in volatile profile of truffles stored at different temperatures.
- Suggest an aroma profile for grading purposes.

**Current Progress**

1. Truffles were received from 10 different (3 states and one territory) in the 2011 season. Over 75 volatile compounds were identified. The typical aroma profile of an Australian truffle is composed of dimethyl sulphide, 2-methyl butanal, 3-methyl butanal, dimethyl ester, formic acid 1-methyl propyl ester, 2-methyl butanol and 1-octen-3-ol. 1,2-dimethoxy benzene and 1,3-dimethoxy benzene were also found in approximately 70% of all truffles analysed. A number of other combinations of chemicals were identified from truffles based on geographical origin. These results will be validated as part of the research in the 2012 truffle season.

2. Methodology for the analysis of truffle volatiles was developed and validated. Seven extraction techniques were investigated. Solid phase microextraction (SPME) was found to be the most efficient method. The SPME fibre that gave the best result contained a combination of divinyl benzene, carboxen and polydimethylsiloxane stationary phases.

3. Arrangements have been made for access to GCO instruments during the 2012 truffle season.

4. GCO analysis requires a fully trained sensory panellist. Training of the panel was successfully completed near the tail end of the 2011 truffle season. As such, this milestone was not met and it is requested that it be redirected to the 2012 truffle season where analysis of truffles by GC-O will be conducted.

5. Preliminary analysis of chemical indicators with sensory descriptors has begun. For example, 3-Methyl Butanal is responsible for the malty/seaweed aroma and 1-Octen-3-ol for the mushroom aroma. A flavour wheel for Australian Black Truffles is currently being developed.
# Research in Progress - Cultural and World Foods

## PRJ-005811 Assessing the potential for a Cochinchin gourd industry in Australia

<table>
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<th>Start Date:</th>
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<tbody>
<tr>
<td>Finish Date:</td>
<td>30/08/2012</td>
</tr>
<tr>
<td>Researcher:</td>
<td>Sophie Parks</td>
</tr>
<tr>
<td>Organisation:</td>
<td>The Department of Primary Industries, an office of the Department of Trade and Investment, Regional Infrastructure and Services</td>
</tr>
<tr>
<td>Email:</td>
<td><a href="mailto:sophie.parks@dpi.nsw.gov.au">sophie.parks@dpi.nsw.gov.au</a></td>
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</tbody>
</table>

### Objectives

The primary objective of this project is to identify the potential for a cochinchin gourd industry in Australia. This will be based on the cost benefit analysis of the production of this crop and the processing of fruits into refined products, and also by identifying pathways and challenges to the development of the industry.

Understanding the basic responses of cochinchin gourd in cultivation is critical to estimating the costs of fruit production and to identify any limitations that might impede the development of this plant as a greenhouse crop. Small scale experimental work, in the form of a greenhouse trial, will permit a fundamental understanding of the crop responses in cultivation, which have yet to be documented.

Financial analysis of this fruit as a processed product will be based on drying, handling and packaging, as for other fruit powders, and will draw on information gathered from processing research already conducted in Australia on cochinchin gourd. Ultimately, the project aims to recommend how the industry stakeholders might proceed in order to establish a cochinchin gourd industry in Australia.

### Current Progress

The primary objective of this project is to identify the potential for a Cochinchin gourd (now more widely referred to as Gac) industry in Australia as a fresh food and as a high quality natural colouring (orange-red) and health supplement (lycopene, carotene). To date, work has focussed on evaluating practices for crop production. For the first time, a Gac crop was produced in a temperate winter using greenhouse technology confirming its suitability as a greenhouse crop. A successful field crop has also been produced in Darwin. Growers in more temperate areas have had difficulty germinating seeds but we have established that cuttings can be struck easily in a range of growing media, without the assistance of rooting hormone. A second greenhouse crop is nearing completion and will allow us to estimate potential yields and production costs. A new PhD project on Gac has commenced and aims to quantify ideal production conditions for high yield and high fruit quality. Currently, information is being gathered from the food manufacturing industry to identify potential pathways for the processing of Gac fruits into a high quality powdered product.
Research in Progress - Cultural and World Foods

PRJ-006141 Identify the agent causing rot in tuber melanosporum and management controls

Start Date: 26/06/2011
Finish Date: 30/05/2013
Researcher: Harry Eslick
Organisation: Hazel Hill Pty Ltd
Email: harry@wineandtruffle.com.au

Objectives
- Confirm effect of soil moisture on the development of truffle rot.
- Establish some baseline figures for the water requirement of truffles to guide growers and researchers into the future.
- Establish if symptoms of rot can be transmitted from diseased to healthy fruiting bodies. Thus confirming whether the disease has a biotic or abiotic cause.
- Identify the microbial pathogen or range of pathogens (if any) responsible for causing rot of truffles.
- We are confident that with the knowledge gained over the past two seasons we can definitively establish whether the rot of truffles is of a biotic or abiotic origin and provide management techniques capable of reducing the incidence of rot.

Current Progress
Over the winter season, results from this year’s experimental program will be collected. There are currently three main experiments in operation: A soil cultivation trial, aiming to confirm the positive effects of soil cultivation established year; an inoculation trial designed to establish if rot can be transmitted from diseased to healthy fruiting bodies; and a continuation of the irrigation trial established last year.

The cultivation trial was established in September of 2011 involving three different cultivation techniques (rotary hoe, and ripping at 2 different depths). Over the last several months extensive sampling has been conducted in order to characterise the soil physical properties in each treatment so these can be correlated with the harvest results.

The inoculation trial was established in early May 2012 using macerated tissue from rotten truffles as the inoculum source to determine if symptoms can be transfer from rotten to healthy truffles. Another two treatments were used consisted of pure fungal cultures from species found sporulation on the surface of truffles. DNA sequencing identified the cultures as Acremonium crotocinigenum and Netria inventa, both have previously been found infecting wild and cultivated mushroom species.
Research in Progress - Cultural and World Foods

PRJ-006267 Improved Decision Making by LOTE Growers - The Next Step

<table>
<thead>
<tr>
<th>Objectives</th>
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<tbody>
<tr>
<td>• Improved and better targeted chemical use reducing the risk of residue violations and promoting a more sustainable industry.</td>
</tr>
<tr>
<td>• Increased market access due to implementation of QA and better chemical management.</td>
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<tr>
<td>• Increased adoption of IPM and safer, more targeted chemical use.</td>
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<tr>
<td>• More sustainable business production practices</td>
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<tr>
<td>• Profitable businesses producing price competitive Asian vegetables</td>
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<tr>
<td>• More self reliant and resilient industry group.</td>
</tr>
</tbody>
</table>

These outcomes will be achieved by the following:

• Facilitate increased adoption of the “Freshcare” QA program for increased market access to a larger number of growers.
• Increase growers understanding of chemical use and record management.
• Facilitate the production and availability of translated labels for key pesticides used by the industry group.
• Develop growers understanding and implementation of IPM practices, reducing the use of broad-spectrum pesticides, better adoption of targeted pesticides and continue the already established trials with native vegetation for beneficial habitat, improved weed control and improved farm hygiene.
• Increase growers understanding of the importance of farm hygiene.
• Increase growers understanding of the impacts of climate change and managing the associated issues of climate variability, reduced water availability and extreme events.
• Improve understanding of OH&S requirements and the importance of farmer and worker health and safety.

Current Progress

All six main activities due over this period have been completed successfully.
A nursery has been contracted grow native plant species for the revegetation IPM demonstration.
Two growers have agreed to participate in the IPM revegetation trials and have commenced preparing sites for plantings.
The contracted nursery has raised 2000 native plants and these will be ready by mid June.
A chemical record keeping workshop was conducted by the Chemical Standards Officer, DPI. The importance of record keeping and the need to improve records was emphasised.
The following documents in Vietnamese/English were given to the growers; Chemical Application record, Chemicals Safety Checklist, Chemical use in protected cropping, Water Quality is critical for spraying.
A benchmarking survey on OH&S was carried out with 60 % grower...
participation.

The results, as well as the discussions held after the survey indicated that basic understanding of safety in number areas (tractors use, packing lines and electrical equipment) required significant work. Comments included the difficulties of convincing workers to address safety issues. Growers do not keep records on safety issues but are aware of the potential for accidents and are concerned about their risks and exposure to workplace safety issues. Worksafe Victoria will conduct a workshop for the growers on OH&S issues in June.
## Research in Progress - Miscellaneous

**PRJ-003853 Broad scale implementation of native grass germination enhancement technologies**

<table>
<thead>
<tr>
<th>Start Date:</th>
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<tbody>
<tr>
<td>Finish Date:</td>
<td>01/08/2014</td>
</tr>
<tr>
<td>Researcher:</td>
<td>Kingsley Dixon</td>
</tr>
<tr>
<td>Organisation:</td>
<td>Botanic Gardens and Parks Authority</td>
</tr>
<tr>
<td>Email:</td>
<td><a href="mailto:kdixon@bgpa.wa.gov.au">kdixon@bgpa.wa.gov.au</a></td>
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### Objectives

The overall aim of this proposed study is to improve opportunities to introduce native grasses, through developing and testing techniques, allowing for the rapid scaling-up of sowing of native grasses onto a broad-scale. Lower establishment costs associated with increased germination performance will result in the greater use of native perennial grasses in pasture systems in the low/medium rainfall regions of southern Australia.

### Current Progress

The current progress of the project has been slower than anticipated however overall project deliverables are still the goal of all partners and will be delivered. After discussions between RIRDC (Alan Davey), Native Seeds and KPBG, the project team has come to the following agreement regarding the Native Grass Germination project PRJ-3853:

1. Key research personnel from the project will meet with Native Seeds management to discuss expectations from the project.
2. We will complete a project variation that will delay the final report until August 2014.
3. Both of the milestone payments currently remaining for this project will be delayed until the final report date.
4. Native Seeds’ contribution will be similarly delayed until that final report date.
5. The project team will still be required to submit Annual Progress Reports in November 2012 and 2013 and Research In Progress Reports in April 2013 and 2014.
Research in Progress - Miscellaneous

PRJ-004777 Cullen australasicum – overcoming a limitation towards its commercial success

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<tbody>
<tr>
<td>Finish Date:</td>
<td>31/03/2013</td>
</tr>
<tr>
<td>Researcher:</td>
<td>Alan Humphries</td>
</tr>
<tr>
<td>Organisation:</td>
<td>Future Farm Industries CRC Ltd</td>
</tr>
<tr>
<td>Email:</td>
<td><a href="mailto:Alan.Humphries@sa.gov.au">Alan.Humphries@sa.gov.au</a></td>
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</table>

**Objectives**

The focus on this initial research has been to identify and develop effective harvesting methodologies to maximise seed yields. Research to date using germplasm of a single accession (SA 4966) has identified techniques (e.g. windrowing) to achieve this. However, reducing seed loss by dehiscence still remains a major constraint to achieving low cost seed, with seed yields equivalent to lucerne of > 1t/ha achievable if dehiscence was negligible.

**Current Progress**

This project has focused on measuring seed yield of 64 half sib families of Cullen australasicum under rain-fed conditions at the Waite Institute in South Australia. Entries have been sown as spaced plants (1x1 m spacing) with 6 individuals per entry sown in a replicated and randomised design.

The 2011/12 harvest of seed and forage yield has been completed. The highest seed yield on an individual plant was 189g, which represents 1.89t/ha on the 1m² spacing used in the trial. Eight lines recorded a seed yield of above 1t/ha, with the highest average seed yield 1.423t/ha (a selection from PA29).

Entry numbers SA41029 and SA40937 had seed yields of 1.090 t/ha and forage yield of over 14t/ha at harvest. The median seed and forage yields for all entries was 0.750 t/ha and 7.5t/ha respectively.

The number of mature seeds per reproductive stem has been identified as the most important seed production component for identification of high seed yielding individuals. This criterion takes into consideration seed dehiscence, which has previously been identified as a constraint to commercial seed production in this species.

The results confirm that excellent seed yields for Cullen under rain-fed conditions are attainable, and that there is substantial variation for both seed and forage yield.
Research in Progress - Miscellaneous

PRJ-005065 Processing seed of selected low-input native grasses for commercial adoption

Start Date: 01/06/2010
Finish Date: 31/10/2012
Researcher: Kendrick Cox
Organisation: The State of Queensland acting through the Department of Agriculture, Fisheries and Forestry
Email: Kendrick.Cox@deedi.qld.gov.au

Objectives

Objectives For two elite ecotypes each of five key native rangeland grass species with demonstrated high potential for crop-based seed production in north Queensland:

- Expand seed production of selected ecotypes of all grasses in the program and assess the impact of best-practice harvesting methods (combine, brush or other) on seed flow and viability.
- Assess methods of seed processing to minimise viability loss while enabling flow through planters used to establish native grasses in rangelands and seed crops.
- Assess establishment performance and forage quality under conditions typical of seed production and end-use. Use best-practice seed treatments for dormancy where necessary.
- Promote the adoption of best-methods. Build a committed ‘problem solving and commercial adoption group’ utilising QDAFF, university and commercial seed processing facilities and expertise.

Current Progress

This project concerns overcoming impediments to the commercial adoption of two varieties each of selected native grasses: low volume of pre-basic seed and the need to adapt commercial-scale seed-processing equipment to enable flow for sowing. Activity over the last 6 months included:

1. harvesting and processing seeds from expanded (pre-basic) areas of blackspear (2), Queensland blue (2) and kangaroo (1) grasses
2. harvesting and processing seeds from original small strips (cockatoo(2), kangaroo(2) and blackspear(2) grasses)
3. sowing pre-basic seed crop of cockatoo grass (1) and raising seedlings for transplant sowing of the remaining kangaroo grass (1)
4. processing seed lots using commercial-grade equipment (blackspear(2), Queensland blue(2), kangaroo (1))
5. Laboratory assessment of kangaroo, blackspear and Queensland blue grasses harvested during 2011
6. completion of an establishment trial to assess establishment of processed seeds
7. field day to prospective seed growers (Native Seeds and DAFF) Over the next six months we aim to process stocks of blackspear (2) and Queensland blue grasses (2) to provide plant seed for first commercial crops during 2012-13. Progress of kangaroo grasses and cockatoo grasses remain delayed because of previous difficulties expanding seed production areas.
Research in Progress - Miscellaneous

PRJ-005420 Cultivating Aust seaweeds for health & nutritional markets: Ulva & Cladosiphon

Start Date: 28/08/2010
Finish Date: 31/07/2013
Researcher: Pia Winberg
Organisation: University of Wollongong
Email: pia@uow.edu.au

Objectives

- To identify the species and strains of Ulva that have been grown in and around aquaculture facilities in NSW, Victoria and Tasmania.
- To identify the species and strains of Cladosiphon genetically and morphologically compared to imported species/strains.
- To establish a propagation protocol for selected species/strains of Ulva.
- To establish a pure culture of one or more Ulva species/strains that exhibit desired traits of blade shape, reproductive stimuli, iron and Vitamin C content as well as ulvan quality in controlled environmental conditions.
- To establish the fucoidan content of the local species of Cladosiphon in comparison to imported species and the local species of Ecklonia and screen for broad gut health (pre-biotic, anti-inflammatory, anti-oxidant and anti-tumoral) properties of Ulva, Myriogleoa (c.f. Cladosiphon), Ecklonia, Hormosira and Porphyra spp.

Current Progress

The project is progressing according to schedule, with the only amendments being to refine the selected areas of bioactivity priorities; total anti-oxidant activity, Omega-3 lipids and polysaccharides as these traits have a closer time to market.

The researchers have combined the efforts with a Canadian research institute to increase the search for suitable Ulva species to over 107 specimens from over 41 sites and 5 states across southern Australia. The team has submitted a paper to the International Journal of Applied Phycology. Importantly, one uniquely Australian recorded species has been identified for the first time on the mainland. This species has been successfully maintained in culture for over close to 12 months, potentially valuable bioactive profiles have been established (anti-oxidant activity, Omega-3 content and promising ulvan profiles) (Milestone outcomes #3-4).

Using genetic barcoding techniques, local Australian candidates of the highly valuable Cladosiphon species have revealed mis-identifications of voucher specimens in herbarium records but also confirmed species from Tasmania. The commercial partner in the project, Marinova, has extracted and preliminarily confirmed high quality fucoidan yield from this species. Further chemical analysis is underway and a review is being undertaken to understand the potential for cultivation of this species (Milestone outcomes #2,5).
Research in Progress - Miscellaneous

PRJ-006338 Review/rejuvenation of the Australian New Crops Website

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<th>Start Date:</th>
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<tbody>
<tr>
<td>Finish Date:</td>
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<tr>
<td>Researcher:</td>
<td>Rob Fletcher</td>
</tr>
<tr>
<td>Organisation:</td>
<td>Dr Rob Fletcher</td>
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<tr>
<td>Email:</td>
<td><a href="mailto:robfletc@gmail.com">robfletc@gmail.com</a></td>
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**Objectives**

The focus of business for RIRDC is to invest in new and emerging rural industries with a view to improving the viability of the rural sector through diversification.

The mission of the Australian New Crops Website (since 1996) has been to support this endeavour through providing information that will assist with the development of new industries based on plants or plant products.

This information assists with finding what is already known about a plant species, identifying the people who have previously worked with the species and providing generic outlines of the necessary steps for the commercialisation of new crop industries for Australia.

**Current Progress**

Four databases are being targeted for the upgrading of the Australian New Crops Website: Science Direct, Wiley Interscience, High Wire and All Oxford; searching and downloading reference citations (and abstracts, where available) have been completed for three (SD, HW and All Oxford) and are well advanced for Wiley (up to the letter, P).

It is also planned to use the Agricola database, but its progress has been slower. Whereas the original plan was to update only the most recent references since the last update of the website, these databases provide a wider coverage than the database previously used, so all available citations and abstracts for each of 82,802 species have been accumulated in individual Endnote libraries.

A preliminary analysis of the most researched species overall, indicates that, apart from the currently grown food, fibre, oil, beverage, forage and timber crops, there are several model species included (Arabidopsis thaliana, Medicago truncatula, Nicotiana benthamiana, Physcomitrella patens (a moss)) along with two medicinal species (Ginkgo biloba, Panax ginseng).

There is also literature appearing on the development of new crop species that are normally considered weeds in some environments (eg Phragmites australis, Spartina alterniflora and perhaps even Dactylis glomerata).
# Research in Progress - Miscellaneous

**PRJ-006635 To investigate closed production systems for ornamental ginger production**

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<th>Start Date:</th>
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<tr>
<td>Finish Date:</td>
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<tr>
<td>Researcher:</td>
<td>Doris Marcsik</td>
</tr>
<tr>
<td>Organisation:</td>
<td>Northern Territory of Australia represented by the Department of Resources</td>
</tr>
<tr>
<td>Email:</td>
<td><a href="mailto:doris.marcsik@nt.gov.au">doris.marcsik@nt.gov.au</a></td>
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**Objectives**

The focus of this research will be to investigate and develop baseline production protocols for growing new ornamental ginger flowers in a closed system both in pots and in-ground.

A range of new Curcuma and inter-specific Zingiber hybrids has been identified as ideal candidates to trial in this closed production system.

The objectives of this research project will be to investigate:

1. the effect of storage duration and temperature on rhizome storage and production;
2. to determine optimum environmental conditions such as photoperiod, light intensity and plant growth regulators to control shoot emergence, growth and flowering; and
3. to determine optimum nutritional levels for producing uniform, high quality ginger flowers.

**Current Progress**

The preparations for the setting-up of experiments for Trials 1, 2, and 3 are on schedule.

The bulking-up of Curcuma rhizomes over the wet season has produced sufficient numbers to begin the setting-up of experiments for the storage and temperature Trial 1 in the next two months.

On completion of Trial 1, these Curcuma rhizomes will then be used in Trials 2 and 3.

In regards to Trial 4, there are not sufficient numbers of Curcuma rhizomes to initiate the experiments this year. Trial 4 has now been deferred to next year’s flowering season. The bulking-up of Zingibers is still on-going for the production of plant material for the in-ground experiments in Trial 2.

Also, in the next two to three months the construction of the tunnel houses for the in-ground plantings for Trial 2 will be completed followed by the planting of the Curcuma and Zingiber germplasm in August/September.

The securing of industry funds for this project is currently in progress with a local wholesale nursery.

These negotiations are expected to be finalised before the due date of the annual progress report.
### Research in Progress - Ginger

**PRJ-008338 Extension & Education Officer - Ginger Industry**

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<th>Start Date:</th>
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<tr>
<td>Finish Date:</td>
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<tr>
<td>Researcher:</td>
<td>Jann Bonsall</td>
</tr>
<tr>
<td>Organisation:</td>
<td>Australian Ginger Industry Association Incorporated</td>
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<tr>
<td>Email:</td>
<td><a href="mailto:jann@lookinglass.com.au">jann@lookinglass.com.au</a></td>
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</table>

#### Objectives

The Australian Ginger Industry Association (AGIA) will engage a Research and Development extension/education officer to manage communication within industry and its supply chain. This will result in increased knowledge transfer with industry and drive an inclusive uptake along the entire supply chain including identifying and engage business development opportunities; and interpretation of R&D projects and delivery of such to stakeholders.

#### Current Progress

Since the establishment of this project the Ext & Ed Officer has been involved in co-ordinating a number of projects and providing a communication network across the ginger industry supply chain.

- Produced 2 newsletters for industry participants including reports on levy funded R&D projects
- Researched the initial stages of a website for AGIA
- Co-ordinated meetings and contacts for the Clean Seed project and provided background information & statistics
- Co-ordinated teleconferences and face-to-face meetings for the Technical Biosecurity Response to the Draft IRA.
- Researched background information to support the Technical Biosecurity Response

Over the following six months it is expected that the website will be operational, two more newsletters will be produced and business partnerships with supply chain participants will have been signed off.

It is the expectation that the Ed & Ext Officer will be co-ordinating regional grower visits to get a better understanding of the specific requirements of each region. There is also a plan to commence a scoping study to outline a marketing campaign so as to bring this project in alignment with the objective to increase consumer demand clearly outlined in the Strategic Plan.
# Research in Progress - Ginger

**PRJ-008343 Controlling Pythium in Ginger: Phase 2**

| Start Date: | 24/02/2012 |
| Finish Date: | 31/07/2013 |
| Researcher: | Mike Smith |
| Organisation: | The State of Queensland acting through the Department of Agriculture, Fisheries and Forestry |
| Email: | mike.smith@deedi.qld.gov.au |

## Objectives

50% adoption of practices to control Pythium rhizome rot within 2 years after completion of research and dissemination of results. Reduced losses and increased production of ginger following successful control of Pythium Soft Rot.

## Current Progress

A series of experiments have been completed and the results will be presented to the ginger industry at their annual field day to be held this year at the Pomona Showgrounds on 14 June 2012. Completed experiments include:

1) 'Best-Bet' farming systems trial for Pythium Soft Rot control in ginger.  
2) Chemical strategies for Pythium Soft Rot control in ginger  
3) Effect of dipping seed in water contaminated with Pythium-infested soil  
4) Effect of Bacillus subtilis treatment on control of Pythium Soft Rot  
5) Testing for resistance to Pythium myriotylum in a range of ginger cultivars and selections  

Major findings for Pythium Soft Rot control indicate that cover crops and organic amendments such as oats and hay mulch, respectively, can quickly lead to improvements in soil organic and labile carbon levels which in turn stimulate increased microbial activity which can act to suppress Pythium myriotylum in the soil. The improved biology also helps create a soil with better water infiltration rates and the mulch has water absorption capacity, therefore conditions necessary for Pythium infection and spread is ameliorated. Further control can be achieved by improving drainage and ‘spot spraying’ areas when disease symptoms first appear.
Research in Progress - Ginger

PRJ-008385 Ginger Tech Support and Minor Use (MUP renewals)

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<td>Researcher:</td>
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<tr>
<td>Organisation:</td>
<td>Australian Ginger Industry Association Incorporated</td>
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<tr>
<td>Email:</td>
<td><a href="mailto:jann@lookinglass.com.au">jann@lookinglass.com.au</a></td>
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### Objectives

Business Development

- New and updated agricultural chemical use permits relevant to maximising production of ginger.
- Documentation and training in the use of these products and systems to achieve more sustainable farming systems.

### Extension of Research & Development Outcomes.

The on-going outcomes of this project need to be clearly documented, published and demonstrated to ginger growers through newsletters, web site, general meetings and field days which include on farm practical demonstrations.

### Current Progress

To date this project has involved and achieved the following results:

1. The provision of technical support for Dr Mike Smith in the development of trial protocols and product research in the specific areas of suitability, rates and application technology.

2. Support, advice and recommendation for both the Pythium diagnostic and ginger seed research project.

3. A review of all Ginger industry permits and requirements for the maintenance of. To date we have achieved an updated permit no 11719 for the increased rates of use of Phosphonic acid and shorter W/H periods for both Metaxyl and Phosphonic acid use in ginger. The symphylid application is currently under review pending approval for the 2012 planting.

4. The documentation and presentation of quarterly technical notes to all AGIA members, aimed at keeping growers up to date with all research and best practice activities.

5. As part of the project both Jann and Rob have established themselves as a point of contact for growers through email, phone and direct contact. Areas which contact includes involves membership, IRA, seed supply, research results and field day activity.

6. The setup, organisation and running of the annual ginger industry workshop and field day on the 14/6/2012 was a cornerstone for this project aimed at the dissemination of the key environmental, social and economic benefits gained from levy expenditure projects.

7. The successful application and achievement on behalf of the AGIA for funding to setup, run, document and disseminate 4 carbon futures sites to review practices that improve SOC, reduce tillage operations and reduce nutrient losses in ginger culture. All of which are key to best practice ginger culture.
RIRDC Completed Projects in 2011-12 and Research in Progress at June 2012

Edited by RIRDC

Pub. No. 12/083

RIRDC produces summaries of completed and continuing projects for each financial year. Our intention is to:

• provide stakeholders with early access to the results of ongoing and completed work to inform their decisions, and

• inform researchers of results to shape research direction.

The New and Developing Plant Industries Completed Projects 2011-12 and Research in Progress at June 2012 contains short summaries of projects funded by the Program. The Program aims to facilitate the development of new and emerging industries based on plant or plant products that have commercial potential for Australia.

RIRDC is a partnership between government and industry to invest in R&D for more productive and sustainable rural industries. We invest in new and emerging rural industries, a suite of established rural industries and national rural issues.

Most of the information we produce can be downloaded for free or purchased from our website <www.rirdc.gov.au>.

RIRDC books can also be purchased by phoning 1300 634 313 for a local call fee.
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