



*Know-how for Horticulture™*

**Development of taro,  
yam, yam bean and  
sweet potato exports  
to Japan and USA**

Prof David Midmore  
Central Queensland  
University

Project Number: VG00087

## **VG00087**

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# Foreword

The coalition Government established, through Senator Hill, a Supermarket to Asia project, the aim of which is to spearhead market share within Asia of fresh foods, capitalising on the “Clean and Green” image of Australian produce. Input barriers and tariffs are disappearing in N.E. Asian (and S.E. Asian) countries, particularly as the farmers in the former can less effectively supply their own demand for food. This is in part due to shrinking areas of land favourable for agriculture, as a consequence of expanded construction, amenity and conservation use and due to an aging agricultural population. An opportunity was identified in principle from a desk top study for the export of root crops of commonly grown species in Asia, and this was followed up by visits to Japan and the USA to verify the market potential. Once determined, research then followed to set up the protocols necessary to produce and deliver the commodities. Focus in terms of immediacy of demand was on Japanese taro and sweet potato.

This project was funded from RIRDC core funds which are provided by the Australian Government, with contribution of some funds from the horticultural industry through Horticulture Australia Limited.

This publication and a related commodity-specific one on the production of Japanese taro, provide up-to-date information on the networking activities and research outputs of public and private sectors in promoting the Asian root crop industry.

This report, a new addition to RIRDC’s diverse range of over 600 research publications, forms part of our Asian Foods R&D program, which aims to support industry in its drive to develop new products and markets and to gain competitive advantage through improving productivity in, and achieving price premiums for, Australian production of Asian foods.

Most of our publications are available for viewing, downloading or purchasing online through our website:

- downloads at [www.rirdc.gov.au/reports/Index.htm](http://www.rirdc.gov.au/reports/Index.htm)
- purchases at [www.rirdc.gov.au/eshop](http://www.rirdc.gov.au/eshop)

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# Executive Summary

This report provides summary and detail of the project aimed to establish ongoing export trade of the Asian root crops taro, yam, yam bean and/or sweet potato to Japan and/or USA. As Australian horticulture and agriculture producers are continually faced with increasing challenges in quality management, pests and diseases, competition from developing countries on the world market and competition from cheaper imports on the domestic market, many are seeking to diversify their production operations and are willing to explore non-traditional crops and markets in Australia and for export. As a result of recent efforts in Australia in the research and development of production and marketing of traditional Asian food commodities, there is increased awareness of the potential for profit by supplying high quality food products to Asian markets in Australia and overseas. This project now adds to the increasing knowledge of production of Asian food crops in Australia.

The information generated from this project is of benefit for producers and marketers contemplating diversification into Asian root crops for domestic and export markets. It is also important as a general case study of attempts to establish relatively new crops for commercial production and export. As well as providing information about requirements for crop production and marketing, this report also indicates some of the challenges that were encountered.

From information gathered in a previous RIRDC project, UCQ-10A, “Consolidating the Asian Vegetable Industry”, and other RIRDC-funded reports on Asian food markets (Vinning, 1995) it was apparent that taro, yam, yam bean and sweet potato had potential for further development in Australian domestic and international Asian export markets.

The objective of this project was to establish a supply chain for the successful ongoing export of taro, yam, yam bean and/or sweet potato to Japan and/or USA. The expected beneficiaries are primarily Australian producers who can establish cost-effective production of good to high quality produce for supply to an increased domestic market and to select export markets. It is also expected that consumers in Australia would also benefit from having an increased variety of nutritious vegetables to choose from.

The project proceeded in two stages. The first stage involved market assessment through information available in literature and databases, and followed up by information from two visits by project participants to Japan and USA. The first visit involved meeting with retail, wholesale, import and food processing companies in Japan and USA to gather information about seasonal supply and price patterns, preferred varieties and quality and presentation preferences. The second visit to Japan involved further investigation of Japanese domestic production and attempts to source germplasm of desired cultivars. The information gathered from the market assessment stage was presented at a workshop in Brisbane and one in Cairns, from which it was decided to focus stage two project activities on the development of production and export of fresh sato-imo, or Japanese taro, to Japan.

Stage two of the project primarily involved production, quality and marketing trials of a sato-imo cultivar already available in Australia. Production trials were conducted at a number of locations in Queensland, NSW and NT. Quality assessment was conducted by NSW DPI and samples of fresh corms were sent to companies contacted during stage one visits to Japan. Several growers coordinated with an Australian export company to send a trial shipment to Japan. Attempts continued throughout stage two to import relevant Japanese cultivars of taro, sweet potato and yam for further production trials.

The decision to focus on export of fresh sato-imo (as opposed to fresh or semi-processed sato-imo and the other root crops) was based on a number of key factors: reliable data was available for the Japanese markets which showed consistent seasonal price and supply volume patterns which were favourable to Australian production windows; the Japanese companies that were visited expressed



most interest in sato-imo; a desirable cultivar of sato-imo was already available in Australia and under small-scale commercial production; and cultivation and harvest machinery already used for potato and sweet potato production could be used or modified for sato-imo production.

Production trials over three seasons have generated sufficient information to recommend production guidelines for Australia. A protocol of quarantine risk assessment for burrowing nematode (*Radopholus similis*) was established with the assistance of Biological Crop Protection and in conjunction with AQIS to meet Japanese plant quarantine restrictions for fresh taro corms. Results of quality assessment experiments of sato-imo corms have allowed recommendation of storage and transport conditions. Feedback from trial samples and a trial shipment sent to Japan has allowed further recommendations for quality control, sorting, packing and presentation of fresh corms. A Growers' Guide for the supply of sato-imo has been produced, and is being published by RIRDC.

Although sweet potato export was not included in stage two of this project, we were able to obtain six Japanese sweet potato varieties which Qld DPIF and NSW DPI will maintain and make available for further investigation by the sweet potato producers. We were, however, unable to source Japanese cultivars of sato-imo directly from Japan, due to a reluctance to release germplasm to other countries, and an unwillingness of AQIS to allow direct imports of germplasm from Japan. In 2003 project team members made contact with a source of Japanese cultivars in Hawaii and have since been involved in the process of importing a number of these into Australia. AQIS requires a long and expensive process of tissue culturing and virus testing for taro importation. So far, seven virus-free lines have been imported, with three more expected for mid-2006.

Five sato-imo producers who met quarantine risk requirements coordinated with an Australian export company to send trial samples and one 1000 kg trial shipment to Japan in 2003. These producers did not proceed with further exports as the price offered by the Japanese importer was too low to allow these producers to be profitable. At that time (2003 and 2004) the Australian domestic prices allowed greater profitability. An underlying issue is the very low price of sato-imo produced in China and imported into Japan. The Japanese are willing to pay more for "clean, green" good quality Australian sato-imo, however there are still a number of important limitations to profitability for Australian producers. One limitation is the current small scale of most sato-imo production operations in conjunction with high labour costs and high cost of specialised machinery to streamline the cleaning and grading of corms. Another is that there has been no established processing outlet for non-premium corms in Australia. Non-premium corms can be peeled then chilled or frozen whole, or further processed for a variety of other food or starch products. Recently (May/June 2005) there have been reports of cheap frozen sato-imo imports from China entering Australia and depressing demand, and therefore price, for fresh sato-imo in the domestic markets in Sydney and Melbourne.

During the time since this project was first proposed China's sato-imo production and supply has increased to Japan and Australia, influencing prices for Australian producers in export markets and domestically. It appears that to be profitable, Australian sato-imo producers need to have medium to large scale operations with specialised harvesting, cleaning and grading machinery and, or alternatively, obtain higher prices by supplying high quality and/or specialty product to niche markets. Additionally, producers could be more profitable if they have an outlet for non-premium corms, such as peeled or even further processed product.

# 1. Introduction

## Background to Project

At the commencement of this project taro, yam, yam bean and sweet potato were all relatively new to Australia. Domestic production was expanding from a small base, with producers then enjoying high prices (Table 1).

Table 1. Markets of Asian root crops in Australia.

	----- Taro -----		----- Yam -----		---- Yam bean ----		-- Sweet potato --		---- TOTAL ----	
	Market	Value	Market	Value	Market	Value	Market	Value	Market	Value
	(t)	(A\$M)	(t)	(A\$M)	(t)	(A\$M)	(t)	(A\$M)	(t)	(A\$M)
NSW <sup>1</sup>	1 300	2.60	500	1.25	360	0.90	2 556	2.04	4 716	6.79
VIC <sup>2</sup>	520	1.04	400	1.00	260	0.65	988	0.79	2 168	3.48
Australia	2 000	5.00	1 000	2.50	800	2.00	10 000	7.40	12 905	16.50

<sup>1</sup>: Referred from Flemington Market Reporting Service, 1996.

<sup>2</sup>: Referred from Melbourne Retail Asian Vegetable Survey, 1999.

(Source Vong Nguyen)

Table 2. Japanese import markets of Asian root crops during a period of 3 years, 2001-2003.

	----- 2001 -----		----- 2002 -----		----- 2003 -----	
	Volume	Value	Volume	Value	Volume	Value
	(t)	(M¥)	(t)	(M¥)	(t)	(M¥)
<b>Fresh market:</b>						
Taro	20,254	1,121	24,887	1,139	29,782	1,291
Yam	3,613	454	4,815	601	4,104	557
Sweet potato	2,034	197	12,408	1,206	13,956	1,200
<b>Frozen market:</b>						
Taro	55,425	7,489	49,660	6,140	49,071	5,153
Yam	2,192	321	3,161	464	2,762	383
Sweet potato	1,139	104	1,433	130	1,351	116

(Source Vong Nguyen)

The crops were thought to have a good potential for export to selected countries, but little work had been done to validate this belief. It is desirable to identify cultivars that are suitable for export early, so that they can become established on the domestic market. The crops are tropical to subtropical, and are therefore well suited to production in Queensland and northern NSW. Multiple production centres would complement each other by extending the availability of a product.

Currently, most of the produce imported by Japan (Table 2) is sourced from China. Even small access to this market represents sizeable income for Australian farmers and others in the supply chain. Example data are presented in Table 2 for three of the crops. This project updated these data and contacted importers in Japan (and USA) to establish preferred supplier status for Australian producers.

**Taro** (*Colocasia esculenta*) is a major crop worldwide with an annual commercial production of around 6 million tons. Australian production is known to be increasing in northern New South Wales, Queensland and Northern Territory. QDPIF extension staff have valued the industry in the Tully / Innisfail region alone as being in the millions of dollars and expanding. Domestic prices are good at

\$2 - \$3/kg, though the crop is labour-intensive and prices are likely to drop due to increased supply. Japan has been identified as a viable export market in numerous studies (Vinning 1995, Lee 1996, JETRO 2004), however, the taro imported into Japan is not the Pacific Taro referred to earlier in this section, but a small-corn taro, (previously classified as *Colocasia esculenta* var. *antiquorum*), a species not widely grown in Australia. The ¥8.6 billion of taro that Japan imported in 2001 at an average of ¥113/kg, was, as mentioned before, sourced mostly from China (figures for fresh and frozen taro combined). This provides opportunity for Australia to deliver taro of higher quality, with a more stable supply and a lower health risk. Australia is currently unable to enter this market because the taro that is grown on a large scale is not that which is preferred by Japanese consumers. This project aimed to overcome this barrier, and to forge links between Australian producers and Japanese buyers through analysis of demand chains. The study also aimed to observe the US market, which imported 27 000 t fresh in 1997, worth US\$23 million, for potential Australian opportunities. This market has been expanding throughout the 1990's and is not limited to specific immigrant communities, as the demand exists on both east and west coast of USA. Therefore it represents a stable opportunity for Australia, with a market that might eventually exceed the growing Japanese market.

One of the major premises for the project was the high price for taro during the summer in Japan (Table 3).

Table 3. Consignment and prices (Japanese yen) of Sato-imo at the Tokyo Central market, Japan (Average of 5 years, 1998-2002)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Volume, t	1133	1213	1014	826	679	556	550	929	1778	2011	1867	2594	15249
Price ¥/kg	182	194	193	179	249	356	326	267	233	196	170	180	209

Source: Tokyoto Chuo-Ichiba – Seikabutsu Ryutsu Nenpo, 2002. Tokyo Seikabutsu Shoho Centa. Tokyo, Japan.

**Yam bean** (*Pachyrhizus erosus*) is native to Central America. It was cultivated by the Toltec, Aztec and Mayan civilisations before its distribution by Spanish galleons to the Philippines. It then spread through other South East Asian countries, India, China the Pacific and West Indies. It is a leguminous plant that produces a refreshing, moist, crisp storage root relatively high in protein. It is consumed raw in salads and low calorie snacks and is favoured in Asian and Latin American dishes where it can replace water chestnuts. Yam bean is not well recognised in Australia although retail prices in 1999 were \$6/kg in Adelaide and \$7/kg in Cairns, indicating an unsatisfied demand. The USA and Canada import Yam bean (also known as Jicama and Mexican water chestnut) from Mexico. Viable Asian markets may exist. Additional potential uses such as starch and natural insecticidal properties require investigation. Apart from marketing, research needs at this stage are basic, including agronomic and phenology studies to coordinate production and quality with market requirements.

**Sweet potato** (*Ipomoea batatas*) has long been a very important food crop to many peoples and despite advances in plant breeding of cereal crops, remains the seventh most important food crop in the world and fourth in the tropics. It was introduced into Australia relatively recently by British colonists while the popular dessert type was first imported as recently as the early 1970's. Only since then has the domestic sweet potato industry developed to its current value of \$10-12 million annually. The many attributes and uses of sweet potato have not yet been exploited in Australia. Australian annual per capita consumption of sweet potato is only 0.5 kg while in the USA it is approximately 3 kg. In China it is estimated to be as high as 100 kg (60 kg fresh plus 40 kg via stock feed) (George Pan, personal communication) and up to 200 kg in parts of Papua New Guinea. Consumption in Australia is increasing and is supported by strong demand from our increasing ethnic Asian and Islander population to whom it is a traditional food. Research and development of the industry in Australia is very recent and limited primarily to plant introduction and evaluation and some aspects of

agronomy including plant nutrition. There is a need for a better understanding of specific product requirement and feasibility of industrial uses. Post harvest handling such as curing, semi processing and packaging, including canning, have not been seriously attempted in Australia but would lead to greater consumer convenience, reduced perishability and increased consumption. Efficiencies in production could be achieved with improved mechanisation and handling.

**Yam** (*Dioscorea* species) is an even less-well known crop in Australia, although much information as to its production requirements has been generated in Africa (eg, at IITA).

Export development of these four commodities face similar challenges in regard to the size and nature of potential export markets, in questions of varietal attributes, and in environmental effects on yield and quality. The experience of the CQU Plant Sciences Group in answering similar questions (Chinese waterchestnut and bamboo industries specifically, and other Asian vegetables generally) was valuable in the conduct of this research, as was our ability to develop and maintain close linkages with receptive growers, exporters and others in the demand chains.

## **Relevance and Benefits**

Current domestic value of the four crops is not known, since much produce bypasses the fresh market system. Sweet potato is estimated to be worth \$10-12 million annually, Pacific taro perhaps \$4-7 million, and yam bean perhaps \$2 million. Data do not exist for yam, but it is known to be imported from overseas into Australia.

As a major outcome from the project, domestic wholesalers will be expected to benefit from a more consistent product in terms of supply and quality, a greater proportion sourced from within Australia, and a more organised industry with which to work. Producers and transporters will be closely linked through a formal association. This will lead to further growth in domestic supply and the possible emergence of secondary industries. We believe that the involvement of local food processors will probably open even more opportunity for export to other countries eg, Korea, Taiwan as frozen and/or dried product.

## 2. Objectives and Methodology

The overall outcome is an established supply chain for the successful export of taro, yam, yam bean and / or sweet potato to Japan and / or USA. This will be achieved by:

- developing product specifications for exporting taro, yam bean and sweet potato to niche markets in Japan and USA, addressing:
  - seasonal windows
  - market preferences (retail and food industry) for variety and quality
- determining suitable production and postharvest methods, addressing:
  - cultivar identification
  - cultivar evaluation / agronomy
  - location / season effect on quality
  - mechanised harvesting and cleaning / sorting
  - other post-harvest and storage requirements for shipment
- facilitating the development of a supply chain, addressing:
  - association of potential exporters
  - trial shipments

### Methodology

The project took place in two stages, with outcomes of the first stage affecting the second.

*Stage 1: Market assessment, August 2001 – to assure confidence amongst Australian producers and export agents of the extent of market opportunity, and to determine product ideotypes.*

Four representatives (producer, germplasm manager, production coordinator, market analyst) spent one week in Japan, followed by one week by one person (market analyst) in the USA. They:

- Met with appropriate companies, including contacts already established by AusAID, Grant Vinning (Asian Markets Research), Vic Lavery (TARA Foods), Michael Daysh (QDPI Cairns), Peter McLaughlin (NORADA), Dr. Vong Nguyen (NSW DPI) and other organisations and companies.
- Identified seasonal price and supply fluctuations of different varieties of each commodity.
- Identified and detailed market preferences for product quality and presentation. Where possible, samples were obtained for RAPD genetic analysis at CQU, for comparison with locally available material in Australia.
- Attempted to obtain preferred varieties and arrange delivery to Australia (they were to have been imported via a parallel project by Dr Vong Nguyen)
- Identified machinery used for commercial production in Japan and USA, and assessed relevance to an Australian industry.
- Observed the Japanese and USA supply chains.

It was essential to the project that a consensus be arrived at among Australian researchers and industry, as to what markets were most achievable and what work needed to be done to secure them. There is already expertise within Australia, but it is by no means complete. A collation of this knowledge and connections within target countries, supplemented by up-to-date input from overseas sources was essential to an efficient and successful project. The market assessment tour was followed by two publicly advertised workshops within Australia (QFVG building, Brisbane Markets, and Qld DPIF, South Johnstone), in which all the expertise regarding the crops was combined. The outcome of the tour and workshop was published, and the specific work to be completed in Stage determined.

*Stage 2: Develop pre- and post-harvest supply*

In the first season, varieties that have been sourced locally and / or imported through stage one of the project were trialled in seven production areas:

Atherton tablelands: Qld DPIF Southedge Research Station

Innisfail: Qld DPIF South Johnstone Research Station  
Central Queensland: Rodney Wolfenden, Harvey Rich  
Southern Qld: Qld DPIF Gatton Research Station  
Northern NSW: Northern Rivers Agricultural Development Association, Murwillumbah region  
Central NSW: NSW DPI Gosford Horticultural Institute  
Northern Territory: NT DPIFM Coastal Plains Horticultural Research Farm, Darwin

- Produce was graded by hand according to the market specifications determined in stage one. Organoleptic and other bio-assays were conducted at Gosford. Some agronomic issues for production in each region were addressed. Minimal amounts of product were shipped for culinary and acceptance tests in Japan.
- In the second and third season, larger trials were placed in fewer locations NSW and Qld to simulate commercial production. Produce was used in a trial shipment to the proposed markets.
- The protocol for assessing risk of infection by *Radopholus similis* was established, in order to satisfy AQIS and Japanese quarantine directives for fresh taro corms
- Experiments for harvesting methodology were determined after completion of Stage 1.
- Germplasm collections were maintained *in situ* (yam bean at CQU Rockhampton, sweet potato at QDPI Gatton, and taro at NSW DPI Gosford, Qld DPI Gatton and at CQU Rockhampton). Some of the collection was genetically assessed using RAPD PCR.
- Post-harvest trials were conducted to determine the optimum shipping conditions for each product. Quality was assessed after storage under different temperature, humidity, controlled atmosphere, heat treatment and packaging.
- Trial samples were sent to the proposed markets, via commercial exporters. One investigator spent 3 days in Japan in November 2004 to obtain feedback of product from buyers and potential markets, and to re-establish previous contacts.

## **Communication/Adoption/Commercialisation Strategy**

A market assessment tour report was produced from stage one of the project and made available to the public via RIRDC publication (<http://www.rirdc.gov.au/reports/AFO/03-052.pdf>). Public presentations of the findings were conducted in NSW and Qld and follow up trials were conducted by collaborating producers with assistance from research personnel. Material for trial shipment was produced on farms. There was direct involvement by a select group of producers, who were well positioned to continue developing the supply chain beyond the time frame of the project. Wider adoption was encouraged by bringing together producers with NORADA and Taro Growers Australia, however no new association was formed specifically for sato-imo or for Asian root crops.

### 3. Outcomes and Results

This section presents information along five fronts:

- Market assessment
- Germplasm and imports
- Field trials
- Post-harvest and quality trials
- Grower organisations and trial exports

#### Market assessment

An initial meeting was held at Queensland Fruit and Vegetable Growers (QFVG) on 28 February 2001 at which information available to date on production statistics and market requirements were presented.

Two separate trips were made to Japan (and one to USA) in June and July 2001. The first trip to Japan and USA followed up on desk-top research of taro, sweet potato and yam to identify regional and seasonal preferences and trends in varieties and markets. Yam bean was considered to be a low priority for Japan. The second trip to Japan established contacts for the acquisition of germplasm of desired varieties. Sample (7 x 5 kg boxes) were sent to four companies at the end of August 2001, and feed-back was excellent, with indications that current wholesale market prices were approx 3,500 yen (A\$ 54.00) /10kg. Two meeting/workshops were held in September (one in Brisbane and one in South Johnstone) to present information from the trips. Business links were established which have led to the shipment of well-received samples of a taro variety, resembling Ishikawa wase, from Australia to Japan. One particular company immediately requested larger volumes. This same company was presented with samples of the 2002 taro crop in May, with the aim of negotiating a larger shipment to allow investigation of product integrity during transport. Based upon the feed-back from the market assessment studies, it was decided to proceed with development of small-corn taro exports to Japan as the main priority.

At a project meeting in April 2002 in Murwillumbah (it was decided that the market research report should also include sections on the Australian domestic markets of taro, sweet potato and yam. Following some research it was evident that there was no useful detailed information available for yam or yam bean.

The market assessment studies terminated with the production of a guide, in the form of an RIRDC report, with colour photos of the various varieties of taro, sweet potato and yam in demand in Japanese markets. (<http://www.rirdc.gov.au/reports/AFO/03-052.pdf>)

As follow-up, in November 2004, one co-principal investigator visited a sato-imo importer in Japan, with whom the project has maintained contact since 2001, and confirmed that there was still a market opportunity in Japan for Australian fresh produce during the Australian production season. The message received was that the second shipment was not as good quality as the first. Although the taste was considered as good, the product was similar to the Chinese product, of various colours and shapes, reflecting the lack of proper grading and sorting by size. The best price for sato-imo in the Japanese wholesale market was A\$2.50/kg (about 2/3 of the price in Table 3), and interest was expressed in importing 500 to 1000 t by Maru over the April to September period (the total demand over this period was estimated to be 5,000-6,000 t. This topic is discussed in more detail later in the report.

A new challenge for Australian producers has presented itself with a significant increase in imports of frozen sato-imo from China to Australia since April 2005. However, cleaned, peeled, blanched and packed fresh taro is still desired by Japanese importers.

## Germplasm and imports

In 2001 all known available germplasm for sato-imo (Japanese taro – *Colocasia esculenta* var. *antiquorum*) was accessed in Australia, and genetic fingerprinting techniques using RAPD PCR and a more sensitive variation known as RAF PCR were developed by a student at CQU. Japanese material was used for comparative purposes in the biotechnology laboratory at CQU, which was AQIS recognised for import of material. For taro, the results revealed that Australian accessions identified as *Colocasia esculenta* var. *antiquorum*, based on morphological characters, were not readily genetically distinguishable from accessions identified as *Colocasia esculenta* var. *esculenta*. The RAPD and RAF results were based on a maximum of 6 RAPD primers and 49 polymorphisms (DNA fragment sizes used as characters). Using more primers and basing the analysis on more polymorphisms would give greater genetic “resolution”. Australian small-corm taro accessions can be compared directly with the Japanese cultivars. RAPD and RAF techniques seem to be not the most suitable DNA fingerprinting techniques for taro, because of the small degree of genetic variation discovered by other researchers. In particular, Emma Mace and Ian Godwin (ACIAR project associated with TANSO and TaroGen) of University of Queensland employed DNA fingerprinting techniques that detect variation in DNA sequences known as simple sequence repeats (SSR) or microsatellites. The SSR techniques are much more sensitive than RAPD and RAF in detecting genetic variation among closely related cultivars of taro.

Due to AQIS quarantine regulations, taro (*Colocasia esculenta*) germplasm cannot be imported to Australia for propagation. The project has therefore been limited to evaluating small-corm taro already available within Australia. One Australian-sourced cultivar (NORADA 1) appears to be physically similar to the Japanese cultivar “Ishikawa wase”. This cultivar is available in large enough volume for much of the research work of the project. Several other small-corm taro cultivars sourced from within Australia also exhibit similarities to Japanese cultivars. Given the availability of taro germplasm in Australia, a variety that meets Japanese market demands, coordinated trials in Gosford, Northern Rivers (NSW) and Gatton, Rockhampton, S. Johnston and Atherton Tablelands (Qld) was used for establishing trials in November 2001. Results from earlier trials in 2000/2001 suggest that yield of this variety is sensitive to growing conditions, and needs to be investigated further. For vegetatively propagated crops freedom from viruses that might reduce yield potential is imperative. Virus testing was conducted by Dr Rob Harding at Queensland University of Technology on leaf samples of “NORADA 1” grown at Coastal Plains, South Johnstone, Southedge, Rockhampton, Gatton, Burringbar and Murwillumbah, and leaf samples of two other small corm taro cultivars grown at Burringbar. Results showed that all samples were free of known taro viruses, with the exception of one sample from Southedge DPI Research Station. The taro bacilliform badnavirus (TaBV) in the Southedge sample has been found in Australia before and is widespread in the Pacific. By itself, TaBV does not seem to cause significant symptoms. This positive result was probably due to infection at the research station rather than from the parental plant material. At this stage the virus indexing exercise has given an initial indication that the widely distributed “NORADA 1” planting stock appears to be free of important viruses.

Seven Japanese cultivars of sweet potato and two Japanese varieties of yam arrived in Australia in May 2002. While in quarantine, the yam tuber material (varieties Yamato Imo and Naga Imo) was found to be infected with viruses and subsequently destroyed. The sweet potato material was in quarantine for a long time; after undergoing heat therapy to eradicate known viruses and being sent back to AQIS for grafting to *Ipomoea* for final verification of the absence of viral symptoms and four lines (Beni Aka, Beni Komachi, Beni Kokei and Kanpachi) were released from quarantine in 2005, into the sweet potato program based at QDPI Gatton. The lines are maintained by QDPI as *in vitro* cultures, and are also available at NSWAg. Two lines (Beni Azuma and Kokei 14 – both very popular in Japan) are still in quarantine, and once released will also be available for grower trials.

Discussions were undertaken to source pathogen-free tissue cultured plants of Japanese taro cultivars, for, as mentioned earlier, AQIS quarantine regulations prohibit taro (*Colocasia esculenta*) germplasm from being imported directly into Australia for propagation. Indeed, taro can only be imported as *in*



*vitro* tissue cultured material via the Secretariat for the Pacific Commission (SPC) Tissue Culture Laboratory in Fiji or the University of the South Pacific (USP) Tissue Culture Unit in Western Samoa. One co-principal investigator undertook negotiations with Dr Mary Taylor (SPC, Fiji) and Dr John Cho (University of Hawaii) during a Taro Conference in Fiji in May 2003. In July 2003, Dr Taylor initiated the transfer to tissue culture of 47 taro accessions from Hawaii, including 10 cultivars originating from Japan (immediately relevant to this project) and 26 accessions from taro leaf blight (TLB) resistance breeding lines (which may be relevant to the Australian taro industry in the future). These accessions are currently in Fiji; the Japanese small-corm accessions underwent meristem culture before being sent to Dr Rob Harding (QUT) for pathogen testing. Once declared pathogen-free, these accessions can be imported into Australia. Currently Fiji sent 10 lines of Japanese taro on 9/9/05. Three lines were infected by Dasheen mosaic potyvirus so only 7 lines are available. The available lines are: MH01Tsuronoko, MH02 Wasehasuba-imo, MH04 Miyako, MH06 Shogatsu-imo, MH22 Akame, MH42 Takenoko-imo, MH44 Shiro-imo.

The three lines that were infected by Dasheen virus are: MH11 Dodare, MH31Tono-imo, MH46 Ebi-imo. We have requested re-importation of the three lines discarded by AQIS, 3 lines (5 tubes each) of Dodare, Tono-imo and Ebi-imo. These lines, if free from infection, should be available in Aug/Sep 2006 to Qld DPIF and NSW DPI for production trials.

The CQU student also ran similar genetic fingerprinting analyses with nine varieties of yam bean available in Australia, and was able to distinguish a yam bean variety sourced from Mexico apart from other varieties sourced from Asia.

## Field trials

Initial plots of 50-100 plants of the taro cultivar tentatively named “NORADA 1” (similar to “Ishikawa wase”) were established in late 2001 at South Johnstone, Southedge, Rockhampton and Gatton in Queensland, at Burringbar and Gosford in NSW and at Coastal Plains near Darwin in NT and larger trials were conducted in NSW to investigate aspects such as variety, planting material, and nutrition and water management. Corms less than 20 g did not survive as planting material; the planting was late (Nov/Dec) due to late receipt of planting materials. Harvesting of these trials commenced in May 2002. The best quality corms resulted from the NT plot. It was concluded that:

- sowing/planting should be completed by the end of October in NSW and Queensland, to avoid the effects of high summer temperatures on young plants
- re-hilling of soil around plants is required throughout the growing season, to avoid exposure of corms to sunlight and to encourage maximum corm swelling.

Due to the inability to import identified desirable taro cultivars from Japan, and with the known acceptance of “NORADA 1” to Japanese companies (as a result of samples sent in 2001), further trials concentrated on this one cultivar. Six other small-corm cultivars were multiplied for establishment of multi-location trials in 2003. However, since the Japanese market accepted NORADA 1, these were not distributed. NORADA also maintained a collection of eight small-corm taro cultivars, which were multiplied at Burringbar NSW. The trials of “NORADA 1” were established in October 2002 at Cairns, Emerald, Gatton, Burringbar, Kyogle and Gosford to compare the effects of planting density, time of planting, “seed” corm size, nutrition and irrigation on yield and quality. Additional data were collected from commercial crops in some of these regions and in Gin Gin. At Gatton, cluster caterpillar was observed and controlled by insecticidal spray. Water management trials were conducted at Burringbar through collaboration between NORADA and Mr Stephen Anderson of Andersons Hydraulics, however, these were discontinued as the crop and the trial could not be maintained due to the grower’s incapacitation through injury. The Kyogle trial was also abandoned due to lack of irrigation water supply. To replace the Kyogle trial, a nutrition trial was then set up in a commercial crop at Cudgen. Trials at the other sites proceeded, however, propagation material was of poor quality when planted, and particularly hot summer conditions were experienced at all sites. Yield data were collected from the Cairns, Emerald, Gatton, Burringbar and Cudgen trials. Yield data were collected from commercial crops in a number of locations in Qld and NSW, on seed corm size: small daughter

corms, golf ball size corms, quarters of mother corms and whole mother corms – quarters of mother corms appear to be best yielding.

Trials of taro “NORADA 1” for the 2003-2004 season included irrigation trials (incorporating aspects from the abandoned 2002-2003 Burringbar trial) at Gosford, soil and nutrition trials at Alstonville, best management options trials (bed type, water delivery method, weed control) at Rockhampton, and planting/harvesting times in Emerald.

Results from 2001/2002 trial comparing mother corm to daughter corm seed material (see attached table) showed that mother corms were better for yield. The definition of mother corm in Table 4 is a corm that has five or more daughter corms. These data are presented for purposes of illustration of the types of data presented in the Growers’ Guide to Japanese Small Corm Taro.

For harvesting, most growers used modified potato diggers to lift corms from the ground, followed by manual labour to pick up, clean and wash, then sort and pack corms. One northern NSW grower purchased a corm cleaner (for removal of roots) and size grader from Japan.

Table 4 Taro 2001-02, CQU-13A: Yield and Corm size of Ishikawa Wase grown at the Gosford Horticultural Institute, Central Coast, NSW, 2001/02.

	Daughter corms		Mother corms		Total		
	Corm #/plant	FW/Plant (g) (t/ha)	Corm #/plant	FW/Plant (g) (t/ha)	Corm #/plant	FW/plant (g)	Yield (t/ha)
<b>G1: Mother corm &gt;120g</b>	42.4	1200.9 16	1.8	231.3 3.1	44.2	1432.2	19.1
<b>G2: Mother corm 60-119g</b>	42.7	1200.0 16	2.0	225.3 3.6	44.7	1468.00	19.6
<b>G3: Mother corm &lt; 59g</b>	36.7	1160.7 15.5	1.4	133.2 1.8	38.1	1293.9	17.3
<b>G4: Daughter corm 40-60g</b>	34.3	908.5 12.1	1.6	129.0 1.7	35.9	1037.5	13.8
<b>G5: Daughter corm 20-39g</b>	36.8	975.6 13.0	1.6	190.1 2.5	38.4	1165.7	15.5
<b>G6: Daughter corm &lt; 19g</b>	28.6	613.1 8.2	1.0	110.8 1.8t	29.6	752.5	10.0

Planting, harvesting and cleaning equipment has been investigated and developed by Mr Craig Lemin of Qld DPIF through his involvement with this project and through RIRDC project DAQ-291A. A number of NORADA growers also experimented with various mechanical systems. Information was gathered on taro harvesting and cleaning machinery used in Japan. This information was forwarded to Mr Lemin and several growers that are developing their own equipment.

A major issue is the lack of any registered pesticide for use on sato-imo (and on Pacific taro).

NORADA reported that a number of its growers have trialled a sweet potato variety obtained from Lester Loader (ex QDPI) as a result of this project, and have found that it is being well accepted in domestic markets with increasing demand. This variety, being marketed under the name “Tweed Sweet Potato” has white skin and white flesh with purple flecks.

## Post-harvest and quality trials

To facilitate the development and maintenance of new export markets, the entire supply chain needs to be geared to meet consumer expectations. Sato-imo destined for the Japanese market must meet stringent quality requirements, both in external appearance and internal quality. The domestic market is less demanding on both accounts, but will not accept cut or misshapen or soft/flaccid corms. After harvesting, corms lose weight by transpiration (water loss) and continue to respire (use stored chemical energy reserves of starch); both result in some loss of fresh weight.

Much of the post-harvest research work at NSW DPI Gosford focussed on the determination of optimal storage and shipping conditions. In one experiment, taro corms were stored at 7°C, 12°C and 20°C for 4, 8 and 12 weeks. For each temperature, corms were stored at a relative humidity of 70% or 90-95%. Corms were assessed for weight loss and sprouting both immediately following storage and after a further 5 days at 20°C. At this final assessment corms were also evaluated in terms of disease incidence and severity, internal colour and textural quality. In a second experiment the effect of curing temperature and duration was also investigated.

Taro quality was acceptable following 4 and 8 weeks storage at either 7°C or 12°C. However storage at 20°C, particularly under high humidity conditions resulted in excessive sprouting. Corms should be stored under high relative humidity to ensure that weight loss is minimised, however care should be taken to exclude any diseased corms from storage. It is essential that corms be surface dry before storage to reduce the incidence of fungal infection. Disease incidence increased dramatically between 4 and 8 weeks at the higher temperatures. 5% and 23% of corms were affected by disease following 8 weeks storage at 7°C and 20°C respectively. Storage of corms is possible at 7–12°C in a dark well-ventilated room for up to eight weeks without quality compromise. Technologically, quality parameters for a product that must go via sea container are not yet resolved.

It is quite evident that appropriate storage conditions are required to maintain desired corm quality during distribution to consumers at the final point of sale, and to ensure sufficient maintenance of quality during household storage before preparation for consumption.

After contact with Food Science Australia product development scientist, Jayanthi Weerasinghe, during the RIRDC Asian Foods project leaders' workshop in Gosford in June 2003, samples of small-corm taro and sweet potato were sent to her for inclusion in trials of processed Asian vegetable products. Limited feedback indicated that the use of taro in a cold salad product for use in hotel food services had potential. We are seeking further detailed results from these trials.

In order to gain information of the organoleptic properties of taro produced in Australia, samples were sent from the trial plots at Darwin, South Johnstone, Southedge, Gatton, Burringbar, Cudgen, Kyogle and Gosford to be subjected to taste panels with a focus group of ten Japanese ladies from the Central Coast region of New South Wales. The main objective of using this untrained panel was to provide some information on the important quality attributes of Japanese taro. The panel was presented with samples from the different growing areas ranging from Darwin in the Northern Territory, to Gatton in southern Queensland and Gosford in central NSW. Representatives from a Japanese restaurant in Sydney were also asked to rate the samples. Although external quality (shape, size, colour) varied, all rated high for taste and internal appearance. A full detail of the parameters evaluated is contained in the Growers' Guide to Japanese Small Corm Taro.

Australian-produced Japanese taro, therefore, appears to be acceptable to Japanese consumers despite the considerable variability. However to maintain market access, quality specifications will need to be developed and adhered to by suppliers. The effect of climate and agronomic practices has been shown to have a large effect on quality and need to be studied further.

## Grower organisations and trial exports

Support to the development of cohesive associations of growers, and to the achievement of trial export consignments was a major activity within this project. Throughout the project there was transparency between researchers and grower counterparts.

An initial meeting of researchers, producers and other industry representatives was held in Brisbane in February 2001. Desk-top studies of the Japanese and USA markets for the Asian root crops were planned, as were plans for group visits to both countries. Two Australian workshops were subsequently held (one in Brisbane with 15 attendees, and the other in South Johnston with 24 attendees) in September 2001 following the tour to present information to stakeholders and to decide which species/varieties should be selected for production, shipping and marketing trials. Business links were established which subsequently led to the shipment of well-received samples of a taro variety, resembling Ishikawa wase, from Australia to Japan. One particular company immediately requested larger volumes.

During 2002, interest in the export of taro to Japan increased thanks to four seminars held by Northern Rivers Agricultural Development Association (NORADA), two on taro and another two on New Asian Crops, plus an industry and project development meeting organised by CQU. The NORADA meetings for taro growers (current and potential) were held in Murwillumbah on 29<sup>th</sup> April and 25<sup>th</sup> November 2002. Both of these seminars included presentations from researchers involved with the RIRDC project.

A project and industry meeting was held on 29<sup>th</sup> July 2002 in Brisbane to present feedback about the taro sample sent to Japan, and to discuss taro industry development as well as the formation of a trading entity or arrangement. Overall, the quality was considered by the Japanese company as very good: external colour needs to be very light, excellent internal white colour, good starch content, but need to remove larger “hairs” (dried roots). They were particularly interested in L (60-80g) and 2L (80-100 g) sizes and oval/egg shape rather than spherical. Grant Vinning developed communications, negotiations and relationships with the Japanese company Maru. In May he presented sample corms from the 2002 harvest and reported that Maru was particularly interested in L (60-80g) and 2L (80-100g) sizes that were oval/egg shaped rather than spherical. For 2003 the NORADA associated growers had a verbal commitment to supply a minimum of 3 x 20’ shipping containers. The seasonal windows of market opportunity had been identified for an Australian taro product that should be readily identifiable by brand name as a unique Australian product.

The Japanese company wanted to market the Australian taro as a premium product, suggesting shipping in 5 kg boxes rather than 10 kg boxes, and stressed that there must be consistent/uniform size and shape grading, to counter cheaper Chinese imports. Product should be shipped at 8°C. Price was discussed, and requires further discussion. If they were willing to take M (40-60g) and S (20-40g) sizes as well – i.e. they take more of the crop – then price could be decreased. A clear need for Australian production to become more mechanised (particularly cleaning and grading) was evident to reduce costs and achieve a reasonable profit margin.

For 2003, NORADA-associated producers aimed to supply the minimum of three 20 ft shipping containers. Dennis Murphy, a trade development officer with the Qld DPI, stepped the 29<sup>th</sup> July meeting participants through the stages involved in developing an export trade and gave some options for business arrangements for producers to consider. Due to the commitment of sending three containers of taro in 2003 from May, at least a temporary arrangement needed to be made for the coordination of sourcing, grading, packing and transporting the produce, the communications and financial transactions with the Japanese company, and feedback. From planting in September 2002 to first shipment in May 2003 there was about nine months. The question as to who deals with the company in this time was raised? An inbound mission was recommended of the Japanese company

representatives coming to Australia to enhance the relationship and inspect taro production, harvesting, grading, and packing. In the afternoon, the producers at the meeting discussed such issues among themselves, in the absence of researchers and industry development people.

With facilitation by Greg McMahon, participants discussed two main subjects:

1. Consideration of trading arrangements and/or entities for the “very short term” and for “long term” success; and
2. The Plan for 2002-2003 for the shipment of at least 3 containers to Japan, and setting up for ongoing trade.

In particular, it was decided that an umbrella “association” or alliance, “TGA-NORADA” (T-N), should be formed to drive activities leading up to and including the first shipments in 2003. The management committee included the presidents of TGA and NORADA, and Philippe Petinaud, Colin Foyster and Steve Pohlman would address technical aspects.

The prospective taro export business organisation considered product brand name(s). Grant pointed out that if we call the product “Australian sato-imo”, then it will only ever be considered another version of Japanese or Chinese sato-imo, rather than a product with its own identity. Grant also stressed that the quarantine inspection procedures for the larger volumes need to be established now, to ensure that quarantine paperwork is airtight and entry of product into Japan is not delayed. (A section on quarantine is to be found at the end of this section)

At the stage of the meeting there were about 40 producers growing or planting small-corm taro, and there was ever-increasing interest from prospective new growers and marketing agents. Key growers had committed at least 50% of their 2002 crop for the Japan 2003 export initiative. NORADA had proposals submitted for funding a central packing facility – this was primarily in response to the taro export initiative, but will be used for many other crops as well.

At a NORADA taro seminar in Murwillumbah on 25<sup>th</sup> November 2002, CQU research officers Dan White and Dee Reeve urged growers that they needed urgently to decide on how they would manage the export operations and further develop the industry – the suggestion was made that NORADA form a Taro Committee to involve growers in the decision-making for these processes, and to alleviate the workload on NORADA president Peter McLaughlin. At least five ‘taro dedicated’ people were required to meet regularly to share the tasks and make decisions for the export business. Some immediate issues for the sub-committee to address include:

- Determine the form of the business entity or choose an industry partner
- All issues concerned with the 2003 trial shipments, e.g. quarantine, grading, packaging, storage, transport insurance
- Inform all NORADA-associated growers of the production, post harvest and trade issues and all associated costs?
- Facilitate standardisation within the industry
- Frequent communication with growers.

The first taro committee meeting was held on 13<sup>th</sup> December 2002 in Murwillumbah and was attended by Dee Reeve. It was discussed that three parties expressed interest in export marketing of small-corm taro from NORADA growers. Various options for the establishment of a company to manage production/promotion/marketing of horticultural produce from the Northern Rivers were presented, with the bottom line of marketing all produce on a full commercial basis, with maximum prices to growers. One company, IHM Australia continued to show interest and IHM representatives attended a number of meetings with the NORADA Taro Committee members, taro growers and project team members over the following months. IHM was contracted to undertake the marketing role for NORADA taro.

On 29<sup>th</sup> April 2003 in Murwillumbah, a Japan Taro Export meeting was attended by project team members, NORADA Taro Committee members, taro growers and IHM Australia representative Frank Collins. Definitive action was decided upon to commence sending samples and trial shipment of the 2003 taro crop to Japan. Leo Burgoyne was appointed as the coordinator of five growers whom would be contributing to the initial export samples and trial shipments.

Towards the end of May a group of taro growers, including those contributing to initial exports, expressed dissatisfaction with information (as opposed to market information gathered by IHM Australia) and coordination from NORADA and the research project. At a previously unplanned NORADA Taro Committee meeting held on 2nd June, the majority of growers that attended expressed a desire to form a group separate from, but still associated with, NORADA. It should be noted that other growers present at this meeting and a number of others who did not attend the meeting did not agree with this course of action at that point in time. The response of the NORADA Board members present was to agree to hand over the development of the taro industry (except for information that is directly related to RIRDC project UCQ-13A) to the new taro group.

Dan White and Phil Wilk (NSW DPI officer) attended the packing of the first 1000 kg trial shipment to Japan on 7<sup>th</sup> June 2003 at Condong NSW. Some of the issues that led to the discontentment of the growers were discussed. Several of the growers admitted that the decision to form a taro group separate from NORADA was actually premature, as they did not have the time, resources and contacts to organise and maintain the new taro group.

A 1000 kg trial shipment was sent to Japan in early June 2003. Initial feedback was provided by the export grower coordinator. Five growers contributed to the trial shipment. Produce from two of the growers was grown in red soil, washed well and hand graded before being brought to the packing shed. The produce from the other three growers was grown in dark soil, required further washing at the packing shed in one case, and was graded using Leo Burgoyne's imported size grader. The feedback from Japan favoured the produce with lighter external colour (that grown in red soil) which was also more consistently size-graded than the produce from the other three growers. The produce that had been grown in dark soil and machine graded was considered less desirable because of the darker external colour and because the sizes of corms within each box were inconsistent. To avoid the inconsistency in the machine-graded product the corms should be pre-sorted according to shape. The machine that was used consists of a rotating cylinder with five sections of grills with increasing apertures. The smaller corms fall through first, and the largest corms fall out at the very end, thus giving six size grades. The inconsistency in weights arises when the corms are inconsistent in shape. The grader does not discriminate shapes and weights, so heavier elongated corms can fall into the same box as lighter spherical corms. The feedback from Japan also suggested that future shipments contain product with all the same external colour – i.e. all light-coloured product or all dark-coloured product, but not both.

The most significant issues were the price and the market timing. The Japanese importer has said that despite the high quality of the Australian product, the price paid (AUD\$7.00/kg) was far too high, and particularly in the summer season, in which they claim that there is very low demand for sato-imo, which is traditionally a winter food. This is contradictory to market information, reported by Asian Markets Research for this project, which shows that although wholesale market and import throughput volume is lower in Japan in May to July/August, the prices are higher than in the Japanese autumn-winter period - this indicates that there is still significant demand during Japan's spring-summer period. Additionally, since representatives of the import company were first met in 2001 and product samples were sent in the period May to August, they were keen to trial imports during the May-August period. Only one trial shipment was sent to Japan in 2003, and although the importer offered to buy more product in September, the export growers decided not to send another shipment because there was no guaranteed minimum price. Although IHM Australia did not comment on whether they would continue to pursue business with this initial import company, they have explored opportunities with other contacts in Japan and the south east Asian region, but would not give more detailed comment (unless permitted by the export growers) due to the commercial nature of the information.

NORADA had achieved a high price on the domestic market through the harvest period (May to Aug) 2002 by selling to only one market outlet in Melbourne at a fixed price of \$40 per 10kg box for three grades of large, medium and small. This collective marketing strategy also helped to maintain a higher price on the Sydney markets. High domestic prices in 2003 to some extent fuelled the lack of commitment from growers to further supply Japan in 2003. The higher returns on the domestic market (soon to be reduced due to oversupply of product) were more attractive to growers than a lower, but steadier, market for Japan. Prices of \$4.50 CIF per kg to Japan were believed to lead to positive returns to growers. However, the issue of what to do with rejects from the Japanese market (i.e. those not sent

to Japan) were not resolved. Overall, a break-even price of \$2.02/kg was estimated for the average grower, as indicated in the Growers' Guide to Japanese Small Corm Taro.

The import company has suggested marketing Australian sato-imo during the traditional sato-imo eating season, to establish an identity of high quality, value-added (distinctly packaged and presented) Australian produce, then continue testing acceptance in the Japanese Spring and Summer. This would necessitate Australian production of sato-imo for harvest from September, or storage of winter crops until September/October. In all cases, current production cost in Australia is still a major limiting factor.

Of major concern for export success was the export growers' dislike of grading to strict specifications and the non-agreement of price that suited both importer and exporter. An independent source of information suggested that the quality of commodity was not bad but the problem was that because of the extremely high price of the purchase, the importers could not achieve a positive margin; in fact they incurred financial losses. The major competitor was China's product, which was much cheaper than that from Australia but their shipping season is from Oct-March. If shipped by sea from Australia perhaps a lower price could be asked for?

Another meeting was held involving as many northern NSW growers as possible to form a consensus view about the development of the small-corm taro industry. This meeting was held on 24<sup>th</sup> June 2003 in Murwillumbah, following a NORADA and NSW DPI taro quality workshop. Unfortunately, there were fewer growers present than at the 2<sup>nd</sup> June meeting. It was decided to leave organising of another meeting with growers, to discuss the issue of forming a new taro organization, until after the 2003 harvest period. It was also decided that the taro committee meetings needed to continue so that there was some momentum from growers, so the date was set as 24<sup>th</sup> July, and the meeting was to be organised by the remaining export growers with assistance from NORADA. This meeting did not occur, and no further grower meetings have been held except for a number of small meetings of the small group of export growers.

It was suggested numerous times to NORADA and to various northern NSW taro growers that all taro growers should become members of Taro Growers Australia Inc, and perhaps form a NSW branch based in the northern rivers region, rather than forming a completely new association. Some advantages of this are TGA's existing organisational structure and constitution, TGA's track record with obtaining R & D funding, contact with other Australian taro growers, and opportunity to coordinate Australian production windows and cooperate in the development of domestic and export market opportunities.

Quarantine/customs is an important issue for import of fresh taro corms into Japan. Japanese quarantine requires an AQIS phytosanitary certificate stating that corms are free of soil, and have been inspected for the presence of *Radopholus similis* (burrowing nematode) during the growing season, and that the soil in which they are grown has been inspected for the presence of *R. similis*. An AQIS-issued phytosanitary certificate declaring these conditions must accompany the corms. Assistance from NSW DPI and Qld DPIF was enlisted for infield sample collection prior to the first large consignment.

One research officer devoted considerable time to communicating with AQIS, NSW DPI and Qld DPIF personnel to initiate the nematode testing program required for phytosanitary certification of taro being exported to Japan. This activity was not foreseen at the initiation of the project. Further, this activity should be the responsibility of the business entity that is exporting to Japan. As the growers involved in the trial shipments had not decided upon the business arrangement by the time of the need for AQIS involvement, the urgent organisation of quarantine-related testing was conducted by the CQU researchers.

A risk assessment strategy was set-up, with input from Dr Graham Stirling (Biological Crop Protection) to rationalise the sampling procedure. High risk locations (those with or close to existing or prior banana crops – a co-host species) required two sampling times – just after planting (soil only)

and pre-harvest (soil, root and corm) giving four samples in total. Other locations were considered as low risk – one sampling time at pre-harvest only (soil, root and corm) giving three samples in total.

There were no charges for sample collection for the 2003-2004 season, however the actual nematode testing cost \$80 per sample. Phil Wilk (NSW DPI) collected NSW field samples then sent them to Graham Stirling (Biological Crop Protection) for nematode testing. About 10-20 growers were expected for the 2003-2004 season. Normal charges for sample collection applied after the 2003-2004 season. Graham Stirling also undertook the same service for Queensland growers. Eventually growers would prefer to be approved to do their own sample collection.



## 4. Discussion, Implications and Recommendations

Stage 1 of the project "...to assure confidence amongst Australian producers and export agents of the extent of market opportunity, and to determine product idea types" was successful, and attendees at meetings in 2001 encouraged the team to continue with the research on pre- and post-harvest supply. Growers that contributed to the trial shipment and sold product domestically, believed that the main issues that needed addressing were reduction of production costs (through mechanisation, and generally more efficient practise), expansion of the domestic market for fresh and semi-processed /value-added products, and further exploration of export markets inside and outside of Japan for fresh and value-added products.

The discontinuation of exports was due to a number of factors, amongst which may be cited the inclement weather of 2003 (extremely dry and with fires, and new legislation regarding reduced entrainment of overland flows), the subsequent risk-aversion of most growers (growers were in the main not main-stream, but part-time, and or small-scale, with little cash backing, and more responsive to short term returns), the lack of attention to detail in quality standards for the Japanese market, the lack of continuity in negotiation over price between Maru and the project team, the raising of the asking price by the contracted marketing agent, and the possible influx of Chinese product beyond the normal seasonal supply identified during Stage I of the project. There may have been some confusion over the original asking and proposed selling prices, for sato-imo and Ishikawa wase names are used in various senses in the Japanese markets. Other major shortcomings of the project may have been the lack of specific hands-on experience in export to Japanese market, the inability of growers to join forces as a robust growers' group to take charge of opportunities to gain funding for technical and administrative support, the gross underestimate for labour requirements to ensure adequate grading, the inflexible nature of AQIS to provide support for development of protocols for nematode sampling.

Sato-imo production is currently very limited in Queensland and NSW, with only several commercial producers in northern NSW supplying to domestic markets. A new challenge for these producers has presented itself with a significant increase in imports of frozen sato-imo from China to Australia since April 2005. However, cleaned, peel, blanched and packed fresh taro is still desired by Japanese importers, and if the practices outlined in the companion Growers' Guide to Japanese Small Corm Taro are followed, and good links with importing companies are established, there is no reason why such a venture should not be profitable.

As with the potential export of other commodities (e.g. Chinese waterchestnut, Midmore and Gersteling, 2004), small scale non-mechanised growers are unlikely to be able to reduce costs to the level necessary to export at a price that would allow for positive net returns.

## 5. Publications and communications arising from the project

### Communications

- NORADA held 3 major seminars in 2001 with over 200 farmers attending overall.
- A Taro work-shop in Murwillumbah in November 2002 attracted over 50 taro growers.
- NBN Television (Channel 9)
- “Asian crops for Tweed”, Luis Feliu, Daily News (Tweed/Murwillumbah), 2 May 2001, p 2.
- “Tweed to put food on Asian tables”, Luis Feliu, Daily News, 9 May 2001.
- “Trade Minister inspects farms”, Peter Caton, Daily News, 1 June 2001, p 4.
- “Export push”, The Weekly (Northern Rivers, NSW), 15 July 2001.
- “To market, to market”, Kevin Elsley, The Land, 2 August 2001, p 19.
- “Farm business set to grow”, David Middleton, Daily News, 24 October 2001, p 1.
- “Big future for Tweed taro”, David Middleton, Daily News, 10 November 2001, p 21.
- “Tapping into taro market”, 2001.
- “Signs show good future for our taro”, Kevin Elsley, The Land, 2 May 2002, p 19.
- “Island crop takes root: taro growers take on Asia market”, Gold Coast Bulletin, 5 June 2002.
- “Taro comes to rescue: Aussie farmers find safety line in a common Japanese vegetable”, Belinda Lavis, Tweed Sun, 24 July 2002, p 18.
- “Water scheme a winner”, Luis Feliu, Daily News, 25 July 2002, p 3.
- “Rural Bonanza: farmers ready to cash in on new crops”, Shan Goodwin, The Northern Star (Lismore/Grafton), 1 August 2002, p 1,3.
- “Local Japanese give taro export nod”, National Marketplace News, August 2002, p 6.
- “Export taro push promises \$50,000/ha”, Kevin Elsley, The Land, August/September 2002.
- “Root crop has export appeal”, David Austin, Small Farms Magazine, August 2002, p 56.
- “Taro market opening in Japan”, The Land – NSW Agriculture Today, August/September 2002.
- “Japanese taro: a new export crop”, Phillip Wilk, The Land – NSW Agriculture Today, 24 April 2003, p 11.
- “Tweed taro crop fails to bear financial fruit”, Daily News, 9 July 2004, p 3.
- “Work needed to market taro: Grower rejects claims sales to Japan have failed”, Daily News, 21 July 2004, p 14.
- The Gold Coast Sun (S.E. Queensland)
- The Farmer Bulletin (Northern NSW)
- “Australian exports have a bright future in Japan”, Barbara Hall, Vegetables Australia magazine (AUSVEG), Vol. 1.1 July/August 2005, p 32-33.
- Crop threat for Tweed farmers”, Daily News, 1 September 2005.
- ABC Regional radio interviews with Peter McLaughlin.
- “New crops for export”, Tablelander (Atherton), 9 October 2001.
- “DNA to help gauge export potential”, Qld Fruit & Vegetable News, May 2001.
- Presentation by D. White: “RIRDC Project UCQ-13A: Development of taro, yam, yam bean and sweet potato exports to Japan and USA”, Agro-Trend Bundaberg Qld, 15 May 2002
- Presentation by Prof D. Midmore to Cane Growers in Maryborough on 20<sup>th</sup> July 2002
- D. Hicks to Third Taro Symposium, Fiji, 21-23 May 2003.
- ABC radio interview with Dan White (taro) and Eric Coleman (sweet potato), Cairns, 19 June 2003.
- D. White. “RIRDC Project UCQ-13A: Development of taro, yam, yam bean and sweet potato exports to Japan and USA” (Taro). DPI Production and Market Development Day, QDPI South Johnstone, 20<sup>th</sup> June 2003.

- E. Coleman. “RIRDC Project UCQ-13A: Development of taro, yam, yam bean and sweet potato exports to Japan and USA” (Sweet potato). DPI Production and Market Development Day, QDPI South Johnstone, 20<sup>th</sup> June 2003.
- S. Newman, E. Lazar, J. Ekman, V. Nguyen, A. Westcott, and D. Harris. (2003). “Effect of storage temperature and relative humidity on the quality of Japanese Taro”. Australasian Postharvest Horticulture Conference, Brisbane, 1-4 October 2003.
- V.Q. Nguyen, D. Midmore, P. McLaughlin, D. Hicks, D. White, S. Newman, J. Bower (2003). Development of high quality and safe taro (*Colocasia antiquorum* Schott) exports to Japan. 8<sup>th</sup> ASEAN Food Conference, Hanoi, 8-11 October 2003.
- Daniel White, David Hicks, Phillip Wilk, Eric Coleman, Suzie Newman, Vong Nguyen and David Midmore (2004). *Development of sato-imo (Japanese taro) production for export to Japan* Second Australian New Crops Conference. UQ Gatton, 20-24 September, 2004.
- Meeting by Dan White with Morita Agricultural Research Centre for processed taro in Bundaberg, Feb 2004. <http://www.uninews.cqu.edu.au/op001-1.php?ra=1143086160&id=1443>

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(<http://www.nre.vic.gov.au/trade/asiaveg/aav-nl-42-2001-sep.pdf>)

“Taro seminar at Murwillumbah”, D. J. Hicks & D. White, *Access to Asian Vegetables*, Issue 50, June 2002. (<http://www.nre.vic.gov.au/trade/asiaveg/aav-nl-50-2002-june.pdf>)

“Root crops for export to Japan”, D. White, D. Midmore, V. Nguyen, D. Hicks, P. McLaughlin, G. Vinning & E. Coleman, *Access to Asian Foods*, Issue 11, August 2002.

(<http://www.nre.vic.gov.au/trade/asiaveg/aav-fl-11-2002-aug.pdf>)

["Select markets for taro, sweet potato and yam"\(RIRDC 03/052 UCQ-13A\)](#), 2003. compiled by G. Vinning, with authors E. Coleman, K. Crippen, W. Gonemaituba, J. Oakeshott, C. Oates, G. Vinning, D. White, and J. Young.

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