



Australian Government

**Rural Industries Research and
Development Corporation**

Cultivation and
sustainable wild harvest of
BUSHFOODS
by Aboriginal Communities
in Central Australia

**A report for the
Rural Industries Research
and Development Corporation**

by Geoff Miers

July 2004

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Foreword

The Australian native foods “bushtucker” industry within both a production horticulture and a traditional wild harvesting context is one that is still very much largely unexplored and the opportunities for commercial horticultural enterprises in this area are considerable.

The bushfood industry is very much based on traditional knowledge, however few Aboriginal people appear to be sharing in the benefits that arise from its activities and the value of their traditional bushfood knowledge and skills is largely undervalued.

In view of their knowledge, skills and interest in bushfoods and their need to develop opportunities for deriving income from their substantial landholdings in Central Australia, Aboriginal people have expressed a desire to be involved in developing commercial options within the industry.

The original aims of the study were to:-

- i) increase opportunities for Aboriginal communities in Central Australia to benefit from involvement in bushfoods industries by developing effective and reliable systems for cultivating selected bushfood species and harvesting, handling, transporting and storing their produce, & ,
- ii) to help ensure long-term viability of bushfood enterprises in Central Australia by investigating social, economic and ecological sustainability of cultivation and wild harvest of bushfood species and developing protocols for monitoring these factors.

This project was funded from RIRDC Core Funds which are provided by the Australian Government.

This report is an addition to RIRDC’s diverse range of over 1000 research publications, forms part of our New Plant Products R & D program, which aims to facilitate the development of new industries based on plants and plant products that have commercial potential for particularly indigenous Australians and for Australia generally.

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- purchases at www.rirdc.gov.au/eshop

Simon Hearn

Managing Director

Rural Industries Research and Development Corporation

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Financial support from the Rural Industries Research and Development Corporation is greatly acknowledged.

Abbreviations

ASDP	Alice Springs Desert Park
ATSIC	Aboriginal & Torres Strait Islander Commission
ATSIC-CDEP	ASTIC- Community Development Employment Program
CAT	Centre for Appropriate Technology
CLC	Central Land Council
DKC	Desert Knowledge Consortium
DIB	Department of Industries & Business N.T.
DLG	Department of Local Government N.T.
DPI&F	Department Primary Industries & Fisheries N.T.
IAD	Institute for Aboriginal Development
ILC	Indigenous Land Corporation
kg	kilogram
km	kilometre
LGANT	Local Government Association of the Northern Territory
OAD	Office of Aboriginal Development N.T.
P&W	Power & Water Corporation
RIRDC	Rural Industries Research and Development Corporation
THS	Territory Health Services

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Executive Summary

Interest in the cultivation and wild harvesting of Australian native foods has increased significantly over recent years, particularly so over the past decade. This increased interest has corresponded with the development of a concept of Australian cuisine, a growing awareness of the value of native foods based on Aboriginal knowledge, and a scientific understanding of the value of the genetic purity of Australian species.

Over 140 species of native food plants are today or have been utilised by Aboriginal people of Central Australia with a range of these plant species having potential value as a marketable food source for the broader Australian and international populations.

Various interest groups from those wishing to diversify farm production through to groups wishing to establish small enterprises in remote communities, where economic opportunities are limited and employment prospects are low, are increasingly developing an awareness of the potential of Australian native foods.

Australian food producing plant species have a long demonstrated usage by Aboriginal communities, this potential often largely unrealised by the broader Australian community. The potential exists for both the production horticulture and wild harvest industries to co-exist and play a significant role in the evolution an Australian native foods industry.

The wild harvest industry in Central Australia currently has an important role in the wattle seed and bush tomato industry with at least six tonne of *Solanum centrale* and over seven tonne of acacia seeds being wild harvested in 2002-2003.

By developing improved cultivars and cultivating specific species the scope for a greater range of plant foods, improved quality and increased reliability becomes possible with the production horticulture industry entering the arena of native foods in Central Australia.

Interest commercially exists for a range of currently identified Australian native foods. The commercial potential for these and other species rests very much with the need for further research and development and the necessity to cultivate improved genotypes and improve management practices and handling, transport and production costs.

Consumer education, improved quality of product, reduction of production costs, and developing marketing potential all are necessary to increase the production potential.

This study has centred around developing a trial Australian native foods garden enterprise on Pantharrpilenhe, a remote Aboriginal community in Central Australia. Underlying this trial the focus has been on:-

- establishing the necessary infrastructure for the enterprise;
- providing necessary and appropriate horticultural training to ensure long term sustainability and independence;
- exploring and developing techniques and management methods appropriate for an arid climate;
- developing species specific management tools and treatments;
- monitoring native food plants of Central Australia with a view to providing a stronger platform for the selection of species and particular cultivars, and with a view to furthering the potential of the wild harvesting industry;
- selecting propagation material and developing propagation techniques with a view to improving plant yields and quality of product.

Twenty native food producing species, fourteen of which are found on Pantharrpilenhe and six in immediate hinterlands within the region, underlie this report. Species selection was based on plant varieties having an established farmgate value, species currently wild harvested in Central Australia and native foods thought to have potential within the Australian native foods industry.

Species ranged from bush tomato and wattle seed through to native bananas, cucumber, onions and potato to wild plums, wild passionfruit and wild oranges.

Within the designated timeframe of nine months much of the focus of the project has centred around the establishment of the production horticulture enterprise.

Establishment issues highlighted included:-

- the importance of maintaining strong community support,
- the necessity for appropriate training and development,
- the need for linkages and continued long term coordinated support from existing agencies and related issues of ongoing funding, technical advice, etc,
- the development of a clear working plan,
- site selection,
- water availability and quality, and,
- the lack of availability of native food plant species cultivated in local nurseries.

A one hectare horticultural block at Pantharrpilenhe was identified, a future development plan drawn up and the area was subsequently fenced, fully serviced and planted out with a variety of Central Australian native food producing species.

Limited numbers of *Santalum spicatum*, the Western Australian sandalwood, were also included. While not identified as a native food species no trials of this valuable exportable crop have been undertaken in Central Australia.

The native food species endemic to Pantharrpilenhe that were trialed included:- *Acacia victoriae*, *Capparis spinosa ssp. nummularia*, *Cucumis melo sssp. agrestis*, *Cyperus bulbosus*, *Marsdenia australis*, *Rhyncharrhena linearis*, *Solanum centrale* and.

Ipomoea costata, *Ipomoea polpha*, *Santalum acuminatum* and *Solanum chippendalei* were the four main non-endemic species to Pantharrpilenhe that were included in the trial. Other species endemic and non-endemic to the region have been cultivated for inclusion and a variety of other species have been monitored in their natural habitats within the region. In total 21 species are being currently cultivated or monitored.

Based on information gathered from within the horticultural block and from monitoring of species within the region plant profiles have been developed. These profiles are categorised under the headings, description of the species, ecology, plant uses, propagation notes, cultivation notes, yields and economic opportunities.

There is a distinct lack of definitive information on native food producing species from Central Australia with particular respect to species behaviour under cultivation. There exists a need for more data collection and research to be undertaken to provide complete plant profiles to assist with the future development of the Australian native food industry, certainly from a production horticultural perspective.

These plant profile notes should equally be relevant in assisting the wild harvest industry.

An initial principal objective of this research project was to increase opportunities for Aboriginal communities in Central Australia to benefit from involvement in bushfood industries by developing effective and reliable systems for cultivating selected bushfood species and harvesting, handling, transporting and storing their produce.

From the establishment of the trial at Pantharrpilenhe a model for future enterprises on Aboriginal communities has evolved. This model needs to be further explored and developed into a user friendly package that is easily understood, provides step by step guidelines and relevant information related to service provision, funding, training, technical assistance and marketing opportunities.

With sustained research the opportunity exists for the development of an “Australian Native Foods Information Kit.” With reference to this research project the information would be specific to plant species from Central Australia.

The development and packaging of this information kit would rely on the further development of the Pantharrpilenhe trial project and the need to develop collaborative links with others working in the field of Central Australian native foods.

The kit would serve to be both comprehensive while being practical and would serve to provide valuable information sought after by communities interested in establishing native food enterprises and by current producers of these horticultural commodities.

Any such kit would include a check list or step by step process of how to establish a production horticulture native foods enterprise, funding and support services, a species list with information on yields and returns, establishment costs, management techniques and tools, key issues within the industry, potential problems and solutions and a list of all industry organisations, support services, funding bodies, product suppliers and relevant references.

The species selection for this trial research project has been based on native foods currently recognised and being marketed and those considered to have potential within the industry.

Working with and consulting with Aboriginal people in Central Australia who for centuries have recognised and utilised a diverse range of plant species for a variety of purposes, the undeveloped potential appears considerable. Listening to and respecting the notable contributions made by people like Peter Latz, Rod Horner and Arpad Kalotas, and, liaising with product suppliers there appears to be considerable scope to expand the current range of Central Australian native foods being wild harvested or commercial cultivated.

In the wattle seed industry most attention is currently paid to *Acacia victoriae* while *Ac. colei*, *Ac. coriacea subsp sericophylla* and *Ac. murrayana* all are highly productive species considered to have a big potential in the wattle seed industry.

Similarly while the focus has been on *Solanum centrale* other solanum species have potential both within and outside the condiment and sauce industries. *Solanum chippendalei* for example is a pleasant tasting species possibly suitable for the glazed fruit industry and as a delicacy for the restaurant trade. It's fruit is also large, almost the size of an apricot. Similarly *Solanum cleistogamum*, the sweetest of all the solanums, has various potential marketing opportunities.

The need to develop improved cultivars and explore a range of marketing opportunities exists with both recognised native food species and the currently little known species.

Research into the development of new cultivars needs further to be supported by the confirmation of appropriate management techniques and tools to improve quality, yields and to reduce production or more specifically harvesting costs.

Much has been written about the potential yields available from specific native foods of Central Australia. Much of this information is based on figures either relevant to wild harvesting or to particular species cultivated outside Central Australia.

While this report sheds some preliminary light on production yields in the first year of establishment, with particular reference to *Solanum centrale* and *Cucumis melo ssp. agrestis*, continued research is required to confirm actual yields on one, two, three and four year old plants and on the influence various watering and fertilising treatments may have on increasing annual yields and being able to induce repeat cropping over a season.

Issues of trellising specific species, companion planting, cultivating crops on natural stands, monitoring climatic factors, factors affecting fruiting and innovative low technology harvesting techniques are all areas requiring further research.

The issue of water management is an issue Australia wide. Much can be gained by exploring the potential benefits of water harvesting, an underlying management technique adopted and incorporated into the Pantharrpilenhe project. The development and efficient management of low pressure irrigation techniques also adopted needs further promotion and understanding within the horticulture industry.

The Pantharrpilenhe “bush tucker” project has provided the opportunity for an Aboriginal community in Central Australia to play an important research role in the emerging Australian native foods industry.

In reality the Australian bushfood industry is largely based on traditional knowledge, however it would appear that few Central Australian Aboriginal people have or are benefiting from the opportunities emerging with the development of this industry. People gaining benefits are largely confined to the area of wild harvesting.

It is hoped that from this research project the people behind the Pantharrpilenhe project and other Aboriginal communities in Central Australia can embrace and become important components of the Australian native foods industry. With increased opportunities built on aboriginal involvement in the establishment and development of the Australian native foods industry it is hoped that increased recognition, employment opportunities and income generation are realised.

While there is some speculation as to the full potential of the native foods industry, specifically to the potential of the current main food species generated from Central Australian species, it is not unrealistic to assume over the next decade that demand will increase significantly particularly as further marketing opportunities are explored and community awareness of the value of “bush foods” is promoted.

With the potential to bring new species and improved cultivars into production, improved efficiency of production and quality of produce, increased marketing and the development of a coordinated approach to production and collection the potential for expansion of the industry is considerable. The doubling or tripling of volume and value of production is deemed conservatively quite achievable within the short term in the Central Australian context.

Centralian College as the current principal research consultant of the “Cultivation and Sustainable Wild Harvest of Bushfoods by Aboriginal Communities in Central Australia” project has been involved with the project for nine months only. Reference should now be made to the revised objectives schedule.

1. Introduction

1.1 Background

1.1.1 The Evolution of a New Industry:

“For tens of thousands of years Aboriginal people have relied on the fruits of this land for their dietary and medicinal properties. We welcome processes that further the economic development of Aboriginal communities.”...prominent Aboriginal leader Mandulwuy Yunupingu (March 2001) in welcoming initiatives that *“...utilise traditional knowledge to promote sustainable businesses for Aboriginal people and their communities.”* (Sawenko, T. 2001)

The Australian native foods or bush tucker industry is an industry still in its infancy despite the fact that Aboriginal people had been using native plants for centuries for food and medicine.

In the late 1970's interest in specific native food species seemingly grew out of the seed collecting industry however even by the early to mid 1980's use of native plant foods did not exist in any commercial food, food processing or hospitality industries. (Horner, R 2002)

The contemporary native food industry very much has its origins arising out of the work of a number of individuals working in a variety of different industries or fields.

Anthropologist Ted Egan had women from Yuendumu collecting seed in the 1960's for the Northern Territory Forestry Branch, while Jack Cook in the early 1970's and later Rod Horner in 1975 began collecting native food seed and sending it interstate for analysis.

Academics such as Vic Cherikoff, who was working at the Human Nutrition Unit at Sydney University in the early 1980's, began work on analysing selected native foods with Central Australian Botanist Peter Latz, Elspeth Young and Jeannie Devitte supplying Cherikoff with samples of seed. (R. Horner 2001)

In 1987 Cherikoff purchased 2.1 tonnes of *Acacia victoriae* collected from Central Australia and began the process of processing, packaging and marketing a “new product” bush tucker. (R. Horner 2001)

“...the contemporary native food/processing industry has a beginning based on the activities of a few individuals largely from the restaurant industry (eg Jean-Paul Bruneteau, Ian & Juleigh Robins and Andrew Fielke, etc), academics (eg. Jenny Brand, Vic Cherikoff, Beth Gott, etc) and horticulturalists (eg. Peter Hardwick, Gil & Meredith Freeman, etc) who identified the potential of incorporating native foods into the wider food/ hospitality / alternative agricultural industries approximately 15 years ago.” (J. Robins, 2001)

While estimates vary it's fairly safe to assume the native food industry today has an annual commercial income of between approximately \$15-\$20 million.

The majority of bush foods are utilised as ingredients in chutneys, preserves, sauces, bread & flour and a variety of condiments although some products are utilised as fresh foods particularly in the restaurant and catering industries. Fresh native foods are also sold throughout the community store network in Central Australia.

The demand for bush tucker as a uniquely Australian product is increasing both nationally and internationally with produce being acquired through both conventional horticultural production and from the more traditional method of harvesting from the wild.

Much of the wild harvesting industry is based on small groups or individuals gathering produce as the product becomes available in favourable years and selling it on to small entrepreneurs in the industry.

The reliance on gathering from the wild can be unreliable as years of extended drought in Central or Inland Australia can be extensive, as can plagues of particular pests, and rainfall at the times of flowering which can with some species result in little or no seed or fruit set.

Throughout Central Australia aboriginal people have high levels of knowledge of bush foods and related skills and have a strong expressed interest in participating in any bush tucker industries centred around the collection and sale of produce for both local consumption and for the national and international markets. (Morse, J. 1999)

Many Aboriginal groups own land throughout Central Australia however realistically few currently have the opportunities and capacity to earn income from their land. Tourism, royalties through mining and pastoralism allow for some economic independence. The need to diversify land use to provide increased opportunities and improve economic viability and reduce dependence is critical.

With respect to Aboriginal communities, the current bush food industry while never likely to be a large industry that can be relied upon to become a major source of income, for some it has the opportunity to supplement existing incomes and provide industry and employment particularly for small community groups.

The cultivation of Central Australian bushfoods is largely undeveloped with few trials being undertaken. Sourcing of locally provided seed, seed germination trials, selection of propagation material, water and nutrient requirements, cultivation methods, factors affecting fruiting, handling and processing are all areas that need exploring.

Following an approach from the Central Land Council in Alice Springs to review, redesign and reschedule and accept the ongoing project management as Principal Research Consultant of the *Pantharrpilenhe Bush Tucker Research Project* the Horticulture Department at Centralian College in Central Australia agreed to work with members of the Pantharrpilenhe Community, the Central Land Council and the Rural Industries Research Development Corporation on this project.

The Centralian College Horticulture Department has been actively involved over an extended period with promoting sustainable horticultural projects on Aboriginal communities and of recent times has been an active participant in promoting and furthering the bush tucker industry in Central Australia.

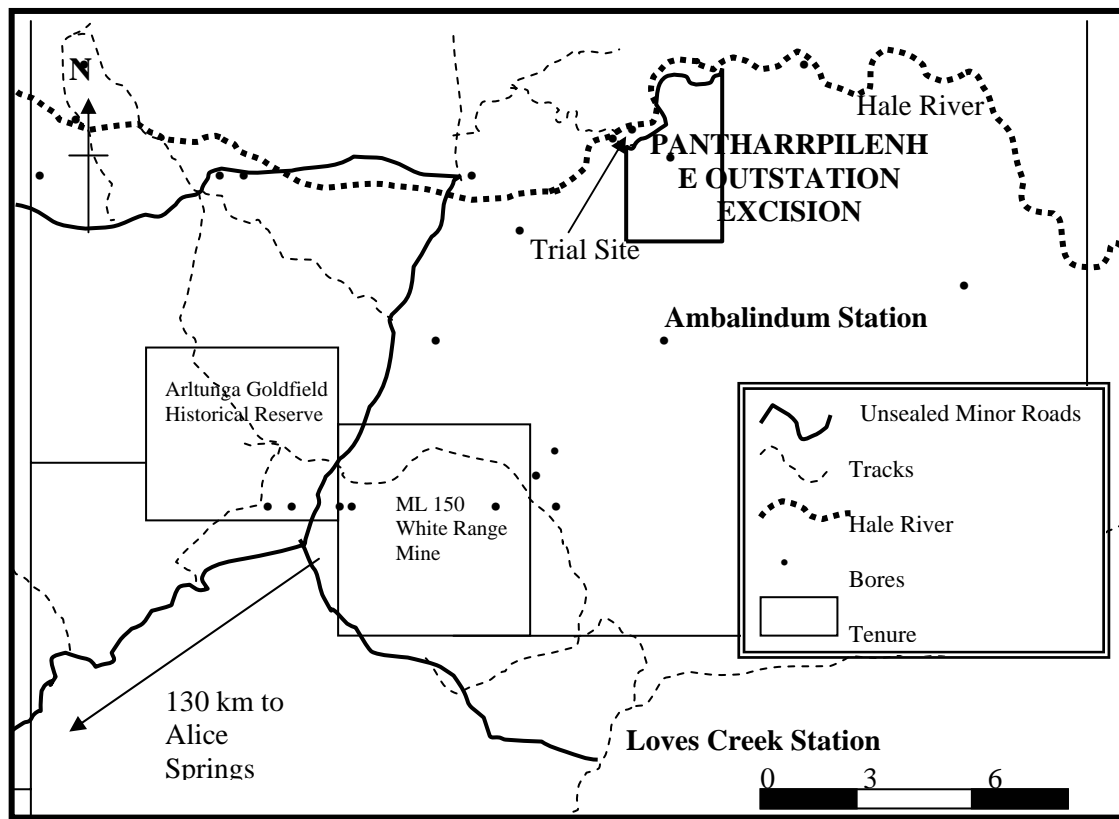
While the principal focus as a leading training provider is one of offering training to clients Centralian College further actively promotes partnerships that foster increased training opportunities, innovation and sustainable enterprise.

The Australian Native Foods or Bush Tucker Industry within both production horticulture and the traditional wild harvesting context is one that is still largely unexplored and the opportunities for commercial enterprises are considerable. This project has the capacity to considerably broaden current horizons.

1.1.2 Pantharrpilenhe The Project Site:

Pantharrpilenhe Outstation is approximately 130 kilometres North-East of Alice Springs, a two hour drive over 79 kilometres of bitumen road and 51.5 kilometres of unsealed winding minor roads and tracks (8 kilometres) through low rugged quartzite hills common to the region.

Map One:



The Pantharrpilenhe excision covers an area of 10 square kilometres. The trial site is located in a north-western corner of the excision, one hectare in size. Pantharrpilenhe is located in the Georgina Range with the Eastern MacDonnell Ranges running parallel and Mount Sir Charles 877m, Mt Laughlen 1167m and Mt Gordon 854m dominating. Geographically, low hills, rocky outcrops and small gorges with water course/riverine communities inter-dispersed throughout the excision dominate. The mostly dry Hale River borders the northern and north-western boundaries of the excision.

The resident population at Pantharrpilenhe Outstation includes 8-10 permanent residents and 8-20 semi-permanent or non-permanent residents. The key proponents of the Pantharrpilenhe Bush Tucker Research Project are John and Marilyn Cavanagh.

Infrastructure includes a bore with accompanying solar pump and two diesel generators, two 10,000 litre tanks located on a nearby hill and one 5,000 litre tank filled by rainwater from the principal residence, two recently constructed four bedroom residences, a series of tin sheds and huts providing other accommodation and storage and machinery sheds.

A vegetation survey reveals the Quartzite hills are vegetated with spinifex, native grasses, small mallee eucalypts, acacias, sennas, *Indigofera leucotricha* (White indigo) and the occasional White Cypress, *Callitris glaucophylla*.

Hakeas, the occasional stunning Ghost gum *Corymbia apparrerinja*, Whitewoods *Atalaya hemiglauca* and the Bloodwoods *Corymbia opaca* also feature in the landscape.

In the lower hills a variety of acacias including *Acacia victoriae*, *Acacia murrayana*, *Acacia ligulata* and *Acacia kempeana*, the Beefwood *Grevillea striata*, the Whitewoods *Atalaya hemiglauca*, *Senna*

ARLTUNGA CLIMATIC DETAILS – January 2002-February 2003

Figure One:

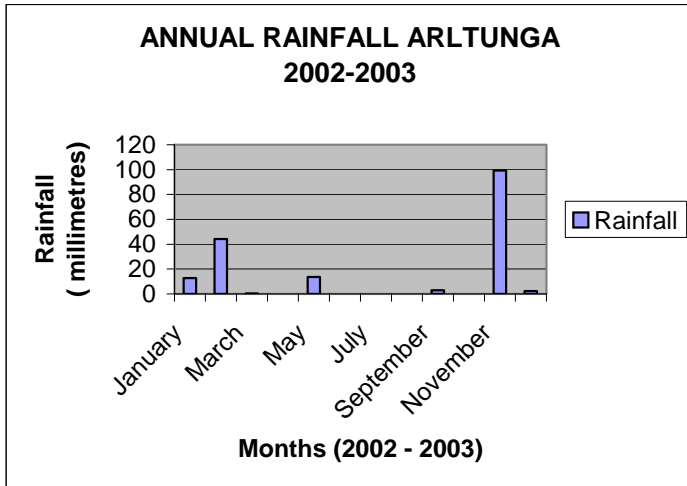


Figure Two:

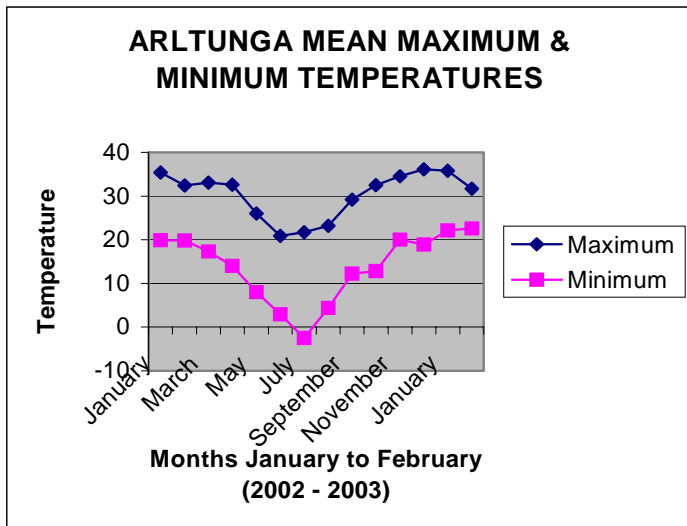
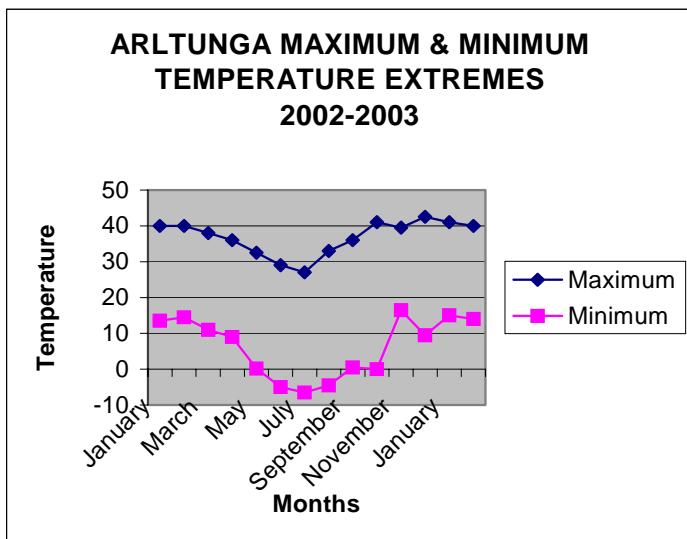


Figure Three:



Ambalindum Station and Arltunga the historic gold mining township, are both equidistant from Pantharrpilenhe, and both have weather recording stations, while the small Pantharrpilenhe community doesn't. Because Arltunga is situated in a very similar geographic location its weather details have been reproduced here.

ARLTUNGA CLIMATIC DETAILS

Table One:

Average Mean Maximum and Minimum Temperatures & Monthly Rainfall Figures for the Year 2002.

Details	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average Mean Maximum Monthly Temperatures 2002	35.4	32.4	33.1	32.6	26.0	20.9	21.7	23.2	29.2	32.5	36.1	29.8
Average Mean Minimum Monthly Temperatures 2002	19.9	19.8	17.3	14.0	8.0	2.9	-2.4	4.4	12.2	12.8	20.0	18.9
Average Monthly Rainfall 2002	12.8	44.2	0.3	0	13.5	0	0	0	2.8	0	99.2	2.3

Table Two:

Minimum Temperatures for July 2002

July Date	1 st	2 nd	3 rd	4 th	5 th	6 th	7 th	8 th	9 th	10 th	11 th
Minimum Daily Temperature 2002	-4.5	-6.5	-3.5	-3.0	-4.0	-3.0	-4.5	-5.5	-4.5	-3.5	-4.0
Month Day	12th	13th	14th	15th	16th	17th	18th	19th	20th	21st	22nd
Minimum Daily Temperature 2002	-3.5	0.0	-2.0	-6.0	-6.0	-2.5	-0.5	-2.0	1.0	2.0	0.5
Month Day	23rd	24th	25th	26th	27th	28th	29th	30th	31st		
Minimum Daily Temperature 2002	0.5	0.0	-1.0	1.5	1.0	1.0	6.0	-2.5	-2.5		

1.2 Objectives

The general objectives of this research were originally to:-

- i) increase opportunities for Aboriginal communities in Central Australia to benefit from involvement in bushfoods industries by developing effective and reliable systems for cultivating selected bushfood species and harvesting, handling, transporting and storing their produce, & ,
- ii) help ensure long-term viability of bushfood enterprises in Central Australia by investigating social, economic and ecological sustainability of cultivation and wild harvest of bushfood species and developing protocols for monitoring these factors.

With respect to the contract agreement signed 1st July 2002 between the Central Land Council and Centralian College, Schedule 2 states that Centralian College will implement the following recommendations:

1. The current site should be abandoned and a more appropriate site developed to overcome inherent soil quality or more particularly salinity problems.
2. The two existing water tanks that feed the current garden need to be relocated to a higher location to overcome problems of water flow/pressure.
3. Permanent water lines need to be installed below ground to ensure a regular supply of water to both the community and to the gardens.
4. Appropriate training needs to be provided to members of the community to ensure skill levels and knowledge are adequate to ensure long term viability of the project.
5. A business/marketing plan needs to be established to provide direction and long term focus.
6. Appropriate infrastructure needs to be established to support the project.
7. Natural stands of food producing plants in the region should be surveyed and documented as required.
8. Flowering, fruiting growth and yields from natural stands need to be documented.
9. Appropriate techniques for an arid zone need to be developed and implemented.

In relation to the original objectives and to the contents of Schedule 2 the project established a number of trail outcomes with a view to:-

- Developing a horticultural block, with appropriate infrastructure, based on producing a number of native food species plants suitable to the region, and subsequently develop a model suitable for other Aboriginal communities. A focus in developing this model rests with strong community participation in the development and maintenance of the project;
- Sourcing species endemic to the region and:-
 - cultivating locally provenanced plant varieties with a view to selecting quality plant material, &
 - exploring and developing differing propagation techniques that don't rely on highly technical equipment, knowledge and infrastructure;
- Surveying and recording natural stands of food producing plants within the region and developing a plant profile.
- Developing and analysing different cultivation techniques and treatments for the management of native food species of Central Australia;
- Developing and analysing different methods of irrigation and exploring the potential for the adoption of "water harvesting" techniques to maximise the benefits of local rainfall;
- Exploring the potential for cultivating native food plants with existing native plant groupings;

2. Developing a Model for Establishing a Horticultural Bush Foods Enterprise on an Aboriginal Community

A principal objective of this research was to increase opportunities for Aboriginal communities in Central Australia to benefit from involvement in bushfoods industries by developing effective and reliable systems for cultivating selected bushfood species and harvesting, handling, transporting and storing their produce. The research project also focuses on the long-term viability of bushfood enterprises in Central Australia.

A focus of the research evolved around developing a horticultural block based on producing a number of native food species plants suitable to the region, a model suitable for other Aboriginal communities. This model would rely heavily on the commitment of the project participants and their consistent efforts in ensuring success of the project.

2.1 Methodology and Materials

2.1.1 Consultation & Gaining Community Support

Integral to the success of the project a focus was made on establishing good communication links and a consultation process that re-enforced ownership of the project by the principal proponents.

A focus in developing a model rested with strong community participation in the development and maintenance of the project, and in supporting community based initiatives.

As principal research consultant links were promoted between the Project Supervisor, community members, Central Land Council as the project manager, and the principal funding body the Rural Industries Research Development Corporation.

Consultation through frequent meetings on site and in Alice Springs were intent on:-

- promoting good working relationships between all parties;
- ensuring maximum community participation with a view to re-enforcing a strong sense of ownership by the proponents;
- reviewing the project as it had evolved prior to Centralian College's involvement with a view to analysing outcomes and bringing resolution to identified problems, &
- working towards developing a revised concept plan for the establishment of a production horticultural enterprise.

2.1.2 Provision of Training

As the principal public provider of TAFE programs in Central Australia, Centralian College offered training to community members for six months in Certificate I in Horticulture.

Horticultural units offered included:- Meet Industry Requirements, Meet Workplace Health & Safety Requirements, Co-operate in the Workforce, Act in an Emergency, Plan Daily Work Routines, Provide Crop Care, Plant a Crop by Hand, Pick a Crop, Provide Planted area Care, Sow Plant Materials, Treat Weeds, Establish Crops, Maintain a Crop and Irrigation Systems Maintenance Activities.

Arthur Dahlenburg and Bart Dessart, Centralian College lecturers, visited Pantharrpilenhe weekly providing instruction and technical advice as required.

2.1.3 Support services

Support services were provided by:-

- Centralian lecturers who through the provision of training and technical advice provided regular support;
- the Central Land Council, a statutory body under the *Aboriginal Land Rights (Northern Territory) Act 1976* who acted as Project Manager;
- links being forged with local industry for technical advice, maintenance and servicing of equipment and machinery and the supply of materials and equipment, &
- the Engawala Community CDEP Program.

2.1.4 Funding

An initial application was made by CLC to the Rural Industries Research Development Corporation for funding to support this research proposal in April 1999. The application was successful. CLC provided in-kind financial support.

Through its provision of training Centralian College provided resources necessary for the delivery of the training program in a remote location and materials to support this training.

Engawala CDEP provided labour and equipment.

2.1.5 Developing a Business Plan

With respect to the original funding application in April 1999 by CLC, the Project Report "*Pantharrpilenhe Bush Tucker Project*" May 2002, the Progress Report "*Pantharrpilenhe Bush Tucker Project*" November 2002 and this report May 2003, a concept model for the enterprise is evolving.

2.1.6 Site Selection

In selecting a site for the enterprise a range of factors were taken into consideration. Reference was also made to problems as identified with the previously chosen site. Site selection criteria included:-

- soil suitability;
- salinity issues;
- pH;
- topography;
- existing vegetation;
- water harvesting abilities;
- proximity to the proponent's abode;
- water quantity & quality.

2.1.7 Water Availability & Quality

Critical to any horticultural enterprise in remote regions of Central Australia is the availability of permanent and reliable water. Quality and quantity of sub-surface artesian water dictates the size of the enterprise and products to be cultivated.

Records were sought from the PowerWater Corporation to provide the necessary data. An analysis of this data was undertaken providing the foundation for informed decision making.

2.1.8 Species Selection & Plant Availability

The range of endemic plants from Central Australia that have multiple uses is extensive. Plant species selected for this project had a strong focus on their food value.

A bush foods vegetation survey was conducted on Pantharrpilenhe and surrounding hinterlands, and, with reference to this survey, the desires of the participants, trends in the Native Foods Industry, the ability to propagate plant material and plant availability, species were selected. Of the twenty-one

species under review fifteen (71%) are found on Pantharrpilenhe, five (24%) are found within Central Australia and one (5%) is from Western Australia.

Where able seed stock or propagation material was harvested or collected from the Pantharrpilenche region by the project participants. Local nurseries and horticultural students were engaged in one form or another to provide locally provenanced material.

2.1.9 Marketing of Product

Contact with major local and interstate industry representatives and the exploration of other marketing opportunities were identified and are being explored.

2.1.10 Intellectual & Cultural Property

A well-established international system of intellectual property laws in the field of bio-development exists with the Plant Breeders Rights framework offering protection to those who develop new plants.

To quote Mike Crow, Desert Knowledge Consortium (2001):-*“The area of intellectual property rights with respect to the knowledge brought into collaboration in the field of bio-prospecting does not have such a framework. In particular the issue of indigenous intellectual property has much to be resolved.”*

Discussions on intellectual property rights have been undertaken with the participants and will further be discussed with CLC lawyers and others involved in industries who are dealing with issues of intellectual and cultural property.

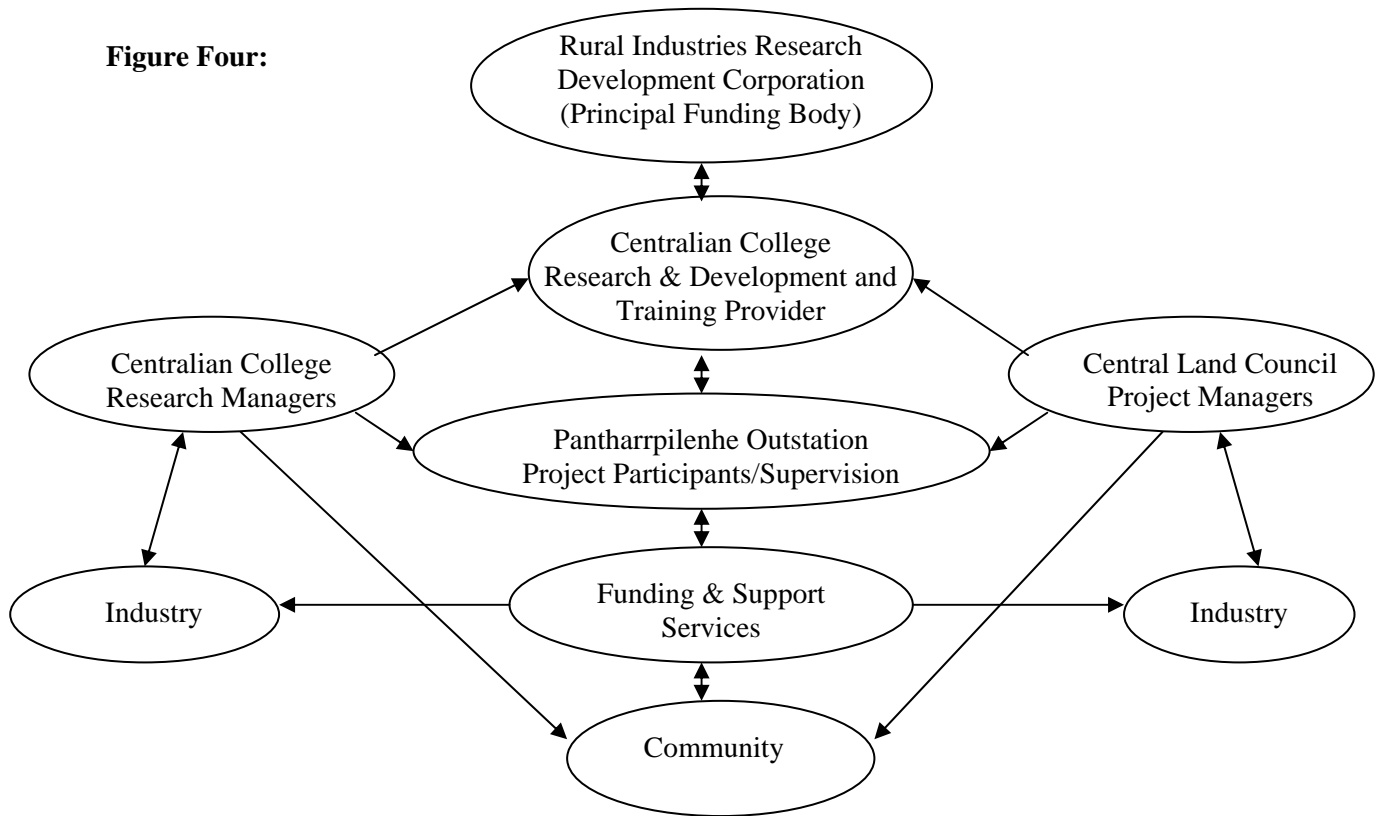
2.2 Results and Discussion

2.2.1 Consultation

A continuous and consistent consultation process was established from May 2002 with weekly meetings in the first instance with the participants, progressing then to fortnightly or as required. Visiting lecturers conferred weekly, and monthly or as required meetings were arranged either on site or in Alice Springs with R&D Co-ordinator Geoff Miers.

A collaborative approach with all parties, with a strong focus on ownership, was promoted throughout the process. Issues of ownership, inclusiveness, independence, self-management and consultation underlie the enterprise concept.

Figure Four:



2.2.2 Gaining Community Support

With the project centred at the small Pantharrpilenhe outstation, one that has a strong family focus, “gaining community support was not an issue considering the fact that John (John Cavanagh the Site Supervisor), and myself had already initiated on behalf of the community discussions with Tangantyerre Land Care staff about establishing a garden on their homeland”. (Cavanagh. M 2003)

The offering of horticultural training and the frequency with which lecturers visited the community provided external support that worked towards re-enforcing the focus and commitment of the proponents.

Leadership within the community and the ability to gain and maintain community support was critical to the success of the project.

2.2.3 Provision of Training

Upwards of two hundred hours of training in delivering the learning outcomes of fifteen horticultural units was undertaken by lecturers from Centralian College. The skills development was not only necessary but critical in the first instance for the establishment stage and later with respect to the management of the enterprise.

With the acquisition of the necessary skills and knowledge the project participants were able with confidence to independently progress the development of the enterprise without the need for constant outside management.

For the long term sustainability of the enterprise, the development of a sound knowledge and skills base has to be considered essential. Provision needs to be made for an extension of this training.

To further the concept of developing the native foods industry thought should be given to the development of a training program within the national horticultural package that has a bush foods focus.

As of 12th December 2002 two students have graduated in Certificate I in Horticulture, with competency achieved in the following horticultural units:-

- Meet Industry Requirements,
- Meet Workplace Health & Safety Requirements,
- Co-operate in the Workforce,
- Act in an Emergency,
- Plan Daily Work Routines,
- Provide Crop Care,
- Plant a Crop by Hand,
- Pick a Crop,
- Provide Planted Area Care,
- Sow Plant Materials,
- Establish Crops,
- Maintain a Crop, and,
- Irrigation Systems Maintenance Activities.

In total seven people enrolled in 6 core modules, 5 level I electives and 4 level II electives.

Table Three:

Student	Core modules Competency Achieved (6 Units)	Level I Electives Competency Achieved (5 Electives)	Level II Electives Competency Achieved (4 Electives)
Student 1	100%	100%	75%
Student 2	100%	100%	75%
Student 3	83.33%	100%	75%
Student 4	33.33%	100%	75%
Student 5	83.33%	100%	50%
Student 6	50%	100%	50%
Student 7	83.33%	100%	75%

2.2.4 Support Services

The need for support services, particularly for communities isolated and many hundreds of kilometres from a main service centre, is undeniable.

As way of background information, in Alice Springs on the 3rd December 2000 a workshop on the “Sustainability of Horticultural Enterprises on Aboriginal Communities” was held with 36 people in attendance. Aboriginal communities represented included:- Ltyentye Community Government Council, Urapuntji Council, Titjikala Council, Intjarnama and Wallace Rockhole. Local government and Territory departments represented included LGANT, DLG, ATSIC-CPED, OAD, DPI&F, THD – Remote Health, DIB, P&W and ASDP. The Desert Knowledge Consortium, Centralian College, Sam Miles & Associates, and the Central Land Council and Tangentyere Council were also represented.

Of the recommendations from the workshop five recommendations had reference to support services with a particular focus on planning, funding, resources, training and the need for continuity and long term support.

These recommendations included:-

- The need to research and prepare a “self-help” pamphlet on what resources are available to assist people in establishing small scale horticultural enterprises.
- To assist communities with information on funding sources to ensure that projects continue once training is completed.
- Developing a Checklist Pro-forma to assist communities/groups to plan effectively for horticulture developments on their land.
- Registered Training Organisations to explore ways to provide communities with the skills and knowledge associated with bush food production.
- The need to investigate the possibility of future employment of an extension officer to promote and assist in the development and continuation of horticultural projects.

For the successful evolution of bush food industries on remote Aboriginal communities the issues as raised in the Workshop recommendations, as above, need addressing.

Over the past decade Centralian College has been involved with providing training and assisting with the development of a number of horticultural enterprises on communities throughout Central Australia.

Of twelve communities where horticulture training has been delivered over the past five years Titjikala (120kms south of Alice Springs), Intjarnama (100 kms west), Laramba (180 kms north-west) and Oak Valley (120 kms south) are the only communities to have maintained or continued to expand their horticultural operations. In each of these four examples support services have been provided over an extended period with horticultural lecturers periodically visiting the communities offering short periods of training and or simply technical advice.

Further with each of these four communities strong leadership supported by a small community has been a common factor.

Further, a consistent theme underlying Aboriginal horticultural enterprises that have maintained momentum are those who have received continued support from agencies such as Centralian College, CLC, ATSIC, CDEP and the Dept. of Remote Health, to name some.

A classic case, with reference to the Pantharrpilehe Project, related to the failure of their generator in November/December 2002, a generator critical to the pumping of water from their artesian bore. With summer fast approaching a reliable water supply was absolutely critical to the success of the enterprise and to the welfare of the community.

The Site Supervisor communicated his concerns re the generator to both CLC and Centralian College. CLC and Centralian College were able to arrange for the generator to be serviced and a replacement generator delivered via Centralian College lecturing staff.

Further to this the project participants held discussions with the Engawala CDEP coordinator and through ATSIC funding a new generator was purchased. This allowed for two generators on site to provide for future contingencies.

This was a classic case of several support agencies being able to pool resources and bring resolution to a situation confronting the Pantharrpilenhe Outstation.

A coordinated support services structure needs to be created whereby agencies are working together co-operatively to minimise duplication and ensure resource allocation is efficient and productive.

Support services need to be able to provide not only immediate assistance with reference to the planning and establishment of projects but also need to be resourced themselves to provide longer term services over extended periods. To increase the chances of project sustainability, remembering

that some horticultural enterprises may take years before full potential is realised, long term support be it intermittently is necessary.

The concept of a support agency providing a Field Officer who is able to regularly visit horticultural enterprises throughout Central Australia and provide technical advice, short bursts of training and bring products, materials and equipment as required is a concept that needs exploring further. A Field Officer would provide a degree of continuity and support. In most cases single agencies are not resourced to provide this service.

2.2.5 Funding

The importance of funding for enterprises on Aboriginal communities is critical to the future success of such programs. Funding support for research and development, infrastructure development, training, employment, management, maintenance and supply of materials are all areas requiring consideration with respect to establishing funding programs.

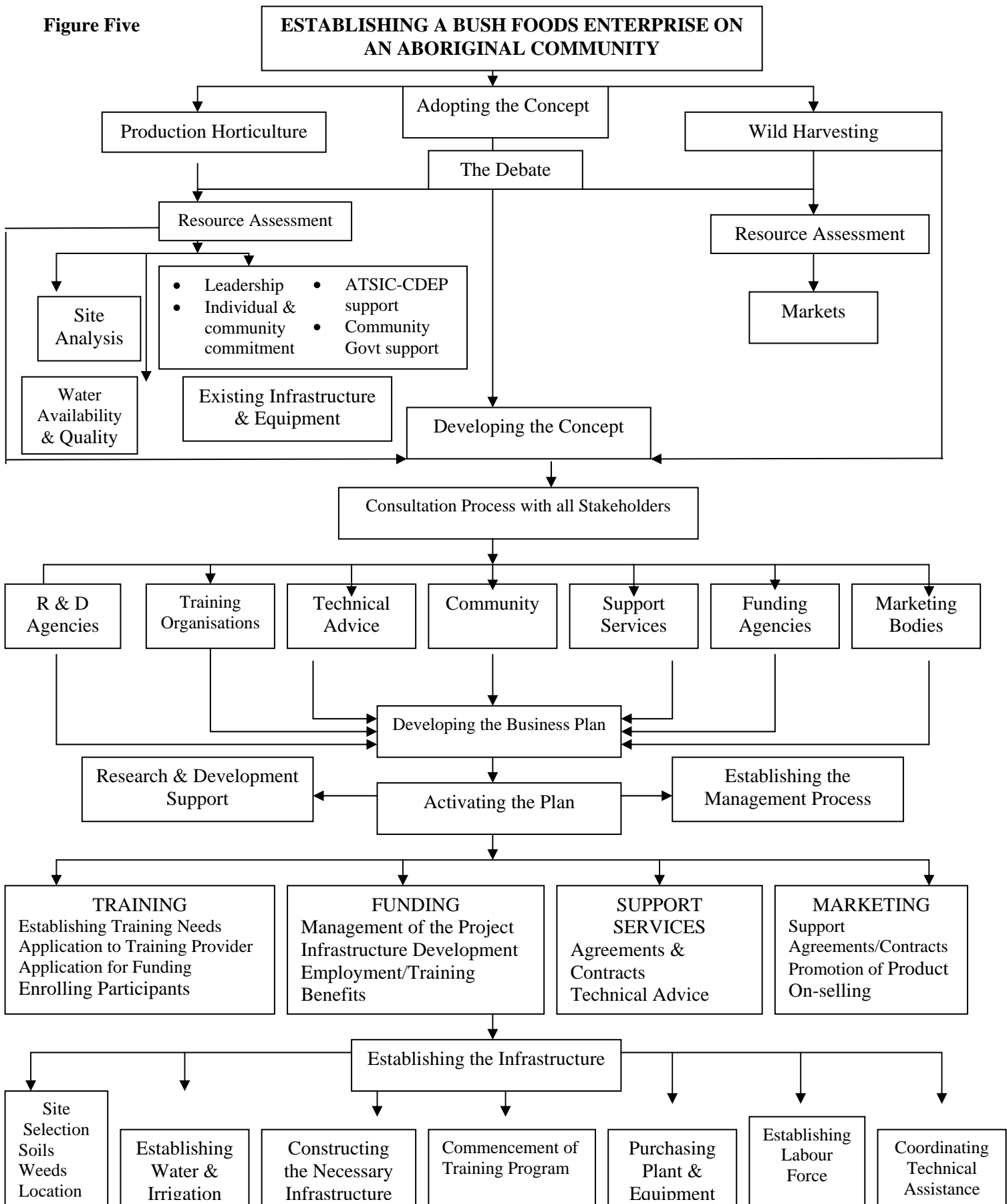
Support for the continued operation of enterprises is an issue that needs further consideration. For example, issues of dollars for diesel to support generators for bores, for machinery and transport is often raised.

Potential funding sources identified include:-

- Rural Industries Research and Development Corporation,
- Indigenous Land Corporation,
- Aboriginal & Torres Strait Islander Commission NT (ATSIC) & ATSIC-CDEP,
- Central Land Council,
- Department of Local Government & Regional Development,
- Department of Health & Community Services,
- Department of Infrastructure, Planning & Environment,
- Department of Business, Industry & Resource Development NT,
- Department of Community Development, Sport & Cultural Affairs NT,
- Department of Education, Science & Training,
- Department of Employment, Education & Training NT,
- Tangentyere Land Care Program,
- Corporate Sponsorship,
- Philanthropic Societies and Organisations,
- Community Councils,
- Coles Indigenous Food Fund
- Other research funding bodies

2.2.6 Developing a Business Plan

Figure Five



2.2.7 Site Selection

In selecting the site for the “Pantharrpilenhe Bush Tucker Research Project” enterprise a range of factors were taken into consideration. Two sites were selected as possible areas for cultivation, preference being given to the site closest to the site supervisor’s residence. Proximity, existing infrastructure, road access and water mains were the deciding factors.

If this native foods project is to continue and expand in the future the second suitable site identified will need to be developed with infrastructure needing to be established.

With reference to the failure of the first chosen site, the key criteria used included:-

- soil suitability/soil type;
- salinity issues
- pH
- existing vegetation;
- topography
- water harvesting abilities, &
- proximity to proponent’s abode
- access
- availability of water

Table Four: A Comparative Site Analysis Using Identified Selection Criteria

Factors in Selection Criteria	Original Site Description	Rating					Current Site Description	Rating					
		1	2	3	4	5		1	2	3	4	5	
Soil Suitability	Fine,sandy,greys,fluffy, claypan soil type					x	Red clay soil, rocky on surface			x			
Salinity	Extremely high up to 8.8 EC mS/cm in places					x	Low EC 1.0 mS/cm	x					
pH	Moderately alkaline, pH 7.6			x			Moderately alkaline, pH water 7.9			x			
Existing Vegetation	Limited, with only salt tolerant plants					x	Range of species with several bush food plants			x			
Site Aspect - Elevation	Sloping site close to riverine environment				x		Hill top location with sloping aspect		x				
Water Harvesting Potential	Moderate				x		Considerable scope		x				
Proximity to Participants	1 to 1.5 kilometres			x			0 to 0.5 kilometres	x					
Access			x					x					
Existing Infrastructure	Nil, close to roads				x		Sheds & road	x					
Proximity to Water Mains	Close to bore	x					Near mains to house	x					

Rating for Table: 1: Excellent 2: Very Good 3: Good 4: Fair 5: Poor

The development of a site selection criteria formulae needs to be documented in a user friendly form and promoted as a key planning component when communities are considering developing a production horticulture enterprise. Technical assistance will be required to provide interpretative information from soil analysis that should be undertaken prior to committing to the development of a horticultural enterprise.

The comparative analysis in Table Four above, of the original site selected where no soil analysis was initially undertaken and the second site currently under cultivation, demonstrates the importance of careful site selection.

Table Five: Soil Analysis Report on Topsoil of Lot Currently Under Cultivation

TEST	RESULT	VERY LOW	MARGINAL	OPTIMAL	EXCESS HIGH *
Nitrate Nitrogen (NO ₃)	1.4 mg/kg	████			
Phosphorus – Colwell (P)	15 mg/kg	████			
Available Potassium (K)	550 mg/kg				████
Available Sulphur – KCT (S)	2.0 mg/kg	████			
Zinc (Zn)	0.20 mg/kg	████			
Copper (Cu)	9 mg/kg			████	
Manganese (Mn)	3.62 mg/kg		████		
Electrical Conductivity (EC)	0.10 dS/m			████	
EC of saturated extract (E _{ce})	1.00 dS/m			████	
Organic carbon (OC)	0.24 %	████			
pH water	7.90	Moderately alkaline			
pH CaCl ₂	7.30				
Soil Texture	CLAY				
Soil Colour	Red				
Free Carbonate	Not Present				
Total Cation Exchange Capacity	12.15 meq/100gm		████		
Aluminium (Al)	0.13 1%			████	
Calcium (Ca)	7.80 64%		████		
Magnesium (Mg)	2.92 24%			████	
Sodium (Na)	0.04 0%			████	
Potassium (K)	1.26 11%				████
Calcium to Magnesium Ratio	2.67	Calcium low			
Potassium to Magnesium Ratio	0.43				

Soil Analysis Report prepared by Paul Talay Agronomist, Pivet Limited, Analysis performed by Labority Wilson Avenue, Werribee, Victoria. Sample Number 10283408 Sample Taken 21/08/2002 Reported 05/09/2002

* The figures of very low, marginal, optimal, etc relate specifically to conventional vegetables.

The site selected for the trial native foods plot has a good depth of top soil, well over one metre in depth. The soil is a red clay and being situated on the hill slope the land is above the high salt clay pan type soils on the lower flats. Being elevated on the hill slope the soil while high in clay content is quite well draining because of its aspect. This should limit potential salt build up problems, provided appropriate management techniques are instigated and maintained.

The site supports a range of native species from lower understorey grasses and herbaceous plants to small to medium shrubs and small to medium trees. Several native food species could be found on the site.

The soil is deficient in zinc, phosphorus and sulphur however it is high in potassium and magnesium. The lack of zinc, phosphorus and sulphur is rectifiable by pre-planting application of specified fertilisers and by fertigation as required. (Taloy 2002)

The necessary infrastructure has been installed and equipment is available to allow for fertigation trials to be undertaken with a view to establishing the nutrient requirements of various bush foods. This area needs further research. To date a pre-planting fertiliser mix and gypsum have been applied to the trial plots under cultivation. This is to be supported by a fertigation program.

2.2.8 Water Availability & Quality

A bore, registration number 16083, was drilled to a depth of 25 metres in 1994 by Gorey & Cole Drillers. From 0 to 3 metres the strata was described as being a sandy clay while from 3 to 25 metres it was granite. At a depth of 10 to 18 metres the bore is yielding 1.5 litres of water per second.

An examination of the water properties of the bore indicate an EC reading of 2760 parts per million (see Table Five below), a level bordering towards the high end of medium range. Plants that have medium tolerance to salt can be grown with the salt levels in the water. *“Careful irrigation practices will need to be implemented so as not to build up salt levels in the soil.”* (Tregea 2002)

The alkalinity level of 380 will need careful management to ensure pH levels do not reach an unacceptable level. *“Alkalinity levels above 125mg/L will cause the pH to rise to unacceptable levels in the soil (without appropriate treatments and management). Levels above 500mg/L will produce severe problems and is not recommended.”* (Tregea 2002)

Potassium and nitrate levels in the water are low and will not cause any nutritional problems such as high vegetative growth versus low fruit production. Potassium and nitrate will need to be added within the fertiliser program, as of any horticultural project. (Tregea 2002)

The use of appropriate irrigation techniques, the establishment of a well managed irrigation regime, the introduction of water harvesting techniques, the careful management of the soil structure with a reliance on using Gypsum and a controlled fertiliser program have all been essential to the overall development and operation of the Pantharrpilenhe horticulture project.

The bore is 1.2 kilometre from the Pantharrpilenhe bush foods trial plot. At the bore site a small solar pump and generator are currently utilised to pump the water from the bore to two 10,000 litre tanks that have been relocated to a hill adjacent to the horticultural plot. The relocation of the tanks was necessary to ensure adequate flow/pressure enabling the irrigation systems to operate efficiently. Previously the main feeder tank was located at the bore site on a 2 metre high stand.

The current solar system is inadequate with respect to meeting the community's and the horticultural enterprise needs. The necessity of having a fully functional diesel generator became apparent in November/December 2002 when the existing generator malfunctioned. Through the support of the ATSIC-CDEP program a new generator was purchased and with support from CLC and Centralian College the existing generator was serviced. Pantharrpilenhe now has two generators to ensure a constant water supply is available.

In the long term investment should be made in a solar system capable of meeting the water quantity needs of the community and the horticulture enterprise. A solar system would overcome the additional problem of having the necessary resources required to be constantly purchasing diesel for the generators.

At 1.5 litres per second or 5,400 litres per hour the size of any horticultural enterprise at Pantharrpilenhe will be restricted by the availability of water. At 1.5 litres per second, pumping for 4 hours in a day 21,600 litres become available to support the community needs and any horticulture enterprise.

Using 16mm Techline with internal emitters at 50cm spacings and discharging 2.3 litres per hour, 1080 metres of line supporting 2,160 plantings on one hectare becomes possible. Pumping four hours a day for 2-3 days per week would support the community needs and two hectares of cultivation.

The unknown factor is the capacity of the bore to sustain the production of 21,600 litres daily for 2.5 days per week over an extended period. The bore is feed from a river basin that is recharged from seepage from the Hale River. Extended periods of drought may affect output. The long term sustainability of the bore is currently unknown. With increased pumping recent tests have revealed the Electrical Conductivity has dropped from 2760 to 2030. Further work is required on this issue.

The issue of water availability within Aboriginal communities versus the establishment of horticultural enterprises is one that needs highlighting as a number of situations or case studies could be cited where community expectations or projects have far exceeded the community's available water capacity.

It is critical in the planning of any horticultural enterprise that the water capacity of the community is established initially with reference to the appropriate Authority.

When initially discussing with a community what its water supply is like the comment is more often than not "We have plenty of water," however on investigation this is frequently not a true reflection of the situation. Natural resource management must be given priority consideration in the very initial investigation into the establishment of any horticultural enterprise on remote communities.

Table Six: Physical & Chemical Analysis of Water for Irrigation Purposes at Pantharrpilenhe

Bore Number: R/N 16083

Element	Level	Comment	Element	Level	Comment
pH	7.6		Chloride, Cl	411	unsuitable
Electrical Conductivity	2760	Medium Tolerance	Sulphate, SO	455	
Total Dissolved Salts	1590	Medium Tolerance	Nitrate, NO	1	okay
Sodium, Na	318	Unsuitable	Bicarbonate, HCO	463	
Potassium, K	7	Okay	Carbonate, CO	0	
Calcium, Ca	111		Hydroxide, OH	0	
Magnesium, Mg	95		Fluoride, F	0.9	
Iron, Fe	0.4	Okay	NaCl (calculated from chloride)	677	
Hardness (as CaCO)	668		Silica	67	
Alkalinity (as CaCO)	380	Potential Problems			

2.2.9 Species Selection & Plant Availability

A bush foods vegetation survey was conducted on Pantharrpilenhe and the surrounding hinterland, and with reference to this survey, of the twenty-one species under review fifteen (71.5%) are species endemic to the region. These species include:-

Acacia aneura,
Acacia coriacea subsp sericophylla,
Acacia kempeana,
Acacia murrayana,

Acacia victoriae,
Capparis mitchellii,
Capparis spinosa ssp. nummularia,
Carissa lanceolata,
Cyperus bulbosus,
Cucumis melo ssp. agrestis,
Marsdenia australis,
Rhyncharrhena linearis,
Santalum lanceolatum,
Solanum centrale &
Solanum cleistogamum

Growing species endemic to the region, species that have adapted to the climatic and soil conditions, provided a sound basis for the development of this enterprise.

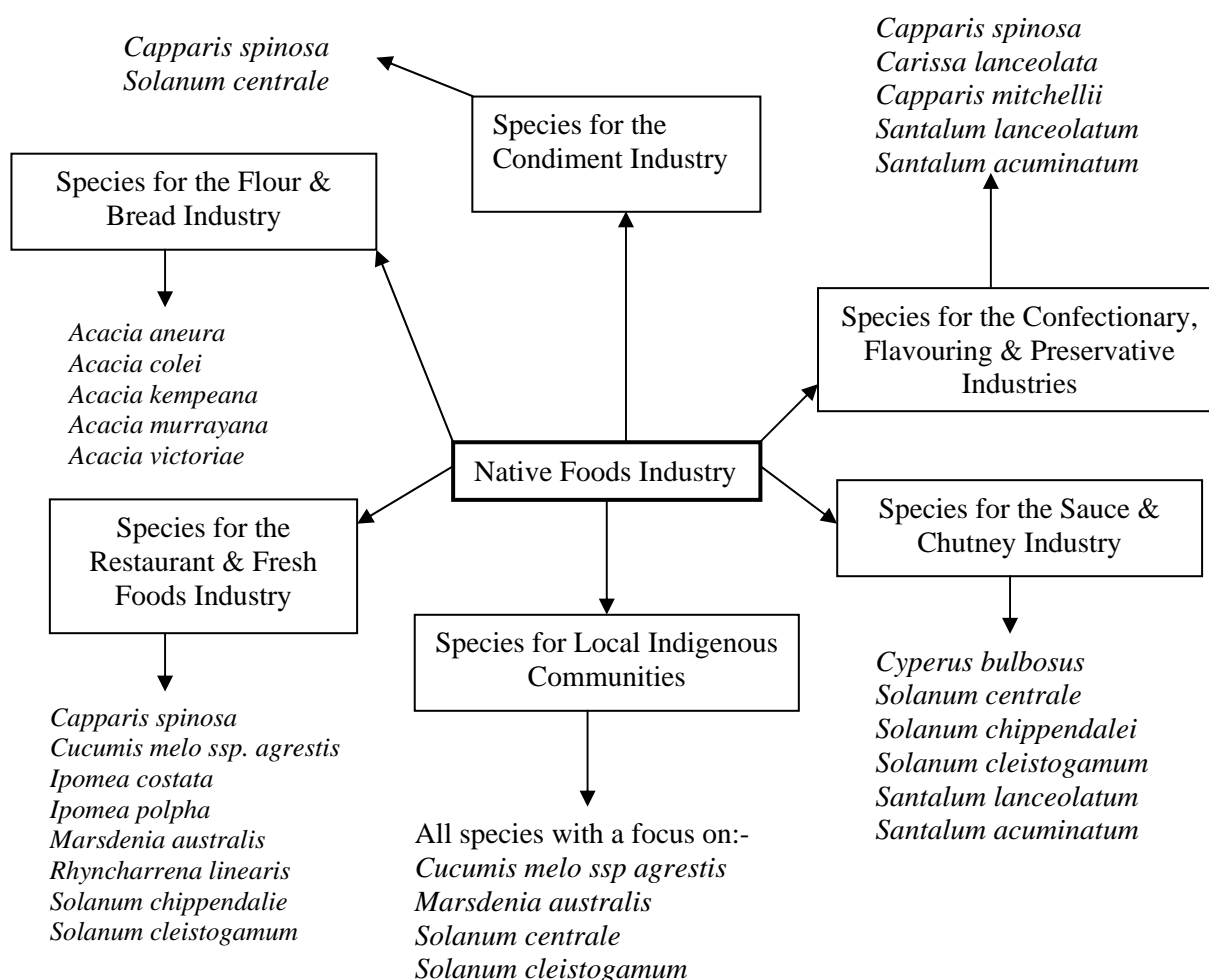
With reference to the desires of the participants, consultation with people within the bush foods industry and trends within this industry several other species were also included. These included:-

<i>Acacia colei</i>	<i>Santalum acuminatum</i>
<i>Ipomoea costata</i>	<i>Santalum spicatum</i>
<i>Ipomoea polpha</i>	<i>Solanum chippendalei</i>

In summary five acacia, three solanum, three santalum, two ipomoea and a selection of individual species were selected. While the focus is purely on native foods in a number of cases species selected have additional qualities in the areas of medicine, timber, artefacts and mythology.

The native food species selected appear to have a range of uses within the local, national and international context. The range of uses include the flour & bread, condiment, confectionary, preservative and sauces & chutney industries, the restaurant trade, the fresh food niche market and further within a local context through community stores on remote communities.

Figure Six Central Australian Native Food Species Selection and Possible Uses



Availability of plant material for the project relied upon the participants collecting seed from species within their region and making available the seed for propagation purposes. In wishing to utilise locally provenanced material, seedling or plant suppliers with some stock available were not utilised (eg Reidy Creek Nursery S.A., Tangentyere Nursery). Many of the species included in the trial, irrespective of wishing to utilise locally provenanced stock, were not available through the commercial industry trade or not available in sufficient quantities.

Students from Centralian College and the Alice Springs Desert Park were contracted to grow stock from seed or vegetative material. This limitation, with respect to the availability of appropriate stock, along with the seasonal considerations, meant that within the time frame it has been difficult to gauge fully the yielding potential of many of the species. Trials need to be continued to fully explore the potential re selection of plant material and yields.

2.2.10 Developing Techniques Suitable for an Arid Zone

In recognising the climatic extremes, the limited and often unreliable rainfall, the soil types where high pH is common and organic content is often limited, techniques appropriate for an arid zone needed to be incorporated into the horticultural enterprise.

Distance or isolation from main service centres, the high cost of freight, and a recognition of the impact traditional ways may have on being able to provide continued care for a horticultural

enterprise are other factors that require specific techniques for the successful development and operation of a horticultural enterprise on an Aboriginal community.

Cultivation and management techniques adopted in this project are listed below with short comments. For complete details refer to the relevant sections following later in the report.

i) Drip Irrigation:

Low pressure irrigation systems that are water efficient are considered critical to the success of the enterprise, noting the issue of water availability and the need to preserve this valued resource.

All plantings are irrigated by 4 litre per hour pressure compensating drippers or by 16mm Techline which has in-line emitters watering at a rate of 2.3 litres per hour. By utilising both these methods of irrigation all water is placed at the immediate root zone of all plants with little wastage.

The irrigation systems are currently controlled by a Galcon battery operated controller that allows for water quantities to be controlled and monitored. Importantly it allows for watering to continue while the participants may be absent from the site.

ii) Water Harvesting:

Noting that the bore water being used has a moderately high salt content and that potential problems could in time arise with issues of alkalinity (refer to Table Five for details) the importance of capturing, temporarily storing and fully utilising all rainwater that falls on the horticultural block is seen as an important management technique that is likely to limit future potential problems.

With the horticultural block located on a hill slope and noting the soil type being red clay and moderately slow draining the introduction of water harvesting techniques into this project was seen as a logical move.

More research is required on developing water harvesting techniques suitable for horticultural projects in an arid zone. The value of water harvesting is much under-appreciated.

iii) Mulching:

Consistent with the need to conserve water, to limit potential salinity and alkalinity problems, to improve soil water holding capacity and to improve the soil's structure stimulating micro-biotic activity in the soil, mulching is considered a potential important cultivation and management technique.

The costs involved in transporting large quantities of mulching material necessitates research being undertaken into the value of using locally available mulching materials.

Limited mulching using aged animal manures and vegetative materials has been undertaken, however greater consideration needs to be given to introducing mulching trials into the project looking also into economically viable and easily transportable mulching alternatives.

iv) Establishing Wind Breaks:

Hot drying winds over up to six months of the year can seriously impact on plant growth. This was particularly noticeable when trials were undertaken with plantings of the native cucumber *Cucumis melo ssp. agrestis* in the open and under the protection of shade cloth. Yields improved by upwards of 400%.

To limit the potential damaging effects of hot dry winds a wind break of *Acacia victoriae* has been established along two boundaries of the horticultural plot. *Acacia victoriae* is a quick growing local native shrub to small tree that produces large quantities of valued seed. The

acacia planting will provide some wind protection along with providing a valuable source of acacia seed. The wind break model needs further developing.

v) Planting with Native Stands:

Trial plantings of *Cucumis melo ssp. agrestis*, *Ipomea costata*, *Ipomea polpha*, *Marsdenia australis* and *Rhyncharrhena linearis* were undertaken next to *Acacia estrophiolata* and *Acacia victoriae*. Initial trials have not proved to be hugely successful.

Further trials with soil and fertilising treatments and differing irrigation regimes need to be undertaken to fully explore the underlying concepts behind this trial.

vi) Soil Conditioning & Fertilising:

Pre-planting fertilisers are critical to the success of any horticultural enterprises in Central Australia as soils are generally limited in their nutrient content.

With reference to water quality and soil types the use of gypsum is considered quite critical to the long term sustainability of many horticultural projects in Inland Australia. The issue of salt built up is of critical importance, controlled irrigation regimes become important.

The need to improve the soil's water holding capacity needs exploring further particularly with reference to horticultural projects that may be developed on sandy soils.

vii) Shade & Protection:

The intensity of the mid-summer sun and the potential devastating impact of winter frosts suggests that an increased focus on providing shade or exploiting natural shade stands needs greater consideration.

Where artificial shade using shade cloth was provided plant growth and health and production yields were significantly greater.

2.2.11 Marketing of Product – Maintaining Ownership

Limited discussions with the project participants have focused on longer term plans related to the marketing of the produce from the native foods project they are currently undertaking.

Initial contacts with major local and interstate industry representatives have been undertaken and considerable time has been devoted to exploring other marketing opportunities.

A focus on the maintenance of ownership and the protection of intellectual and cultural property rights have been given considerable thought and discussion. It is anticipated that as the project progresses and milestones are reached that increased and alternative marketing opportunities will be fully explored and developed.

3. Plant Selection and Propagation

Integral to the integrity of the research project, plant species, where able, were selected from material obtained from within the Pantharrpilenhe Excision.

The aim was to cultivate locally provenanced plant varieties with a view to selecting quality plant material, and in the process, explore and develop different propagation techniques that where able didn't rely on highly technical equipment, knowledge and infrastructure.

3.1 Methodology and Materials

3.1.1 Conducting a Local Flora Survey

A range of plant habitats were surveyed to ascertain the presence of native food producing species and their densities within these habitats. Habitats included spinifex communities on hills, woodlands on plains country, mulga communities, claypan flood-out communities and watercourse or riverine communities.

A diverse range of food producing species were found to be growing throughout the region in a variety of habitats.

3.1.2 Monitoring the Flowering, Fruiting and Seeding of Local Native Food Species

A number of food producing species were monitored over a period to ascertain details about the plant species. Plant descriptions were compiled, details of their ecology, flowering and yields were all recorded as was appropriate.

3.1.3 Basis for Selection of Species

Species selected for the research project relied largely on species endemic to the region although five species from outside the region were included.

Criteria used for selecting the species for trial included:-

- species being endemic and plentiful to the region;
- species suitable for cultivation with reference to the nature of the trial plot;
- species currently in demand by the Native Foods Industry, &
- species considered to have potential in the Native Foods Industry.

Further, consultation with the participants and availability of plants or propagation material had some influence on species selection.

3.1.4 Species Selected

With reference to the criteria as detailed in the immediate section above twenty-one species were chosen of which fifteen (71.4%) were endemic to the region. Reference should be made to Section 2.2.9.

Species chosen for the trial project that were endemic to the region included:-

Acacia aneura,
Acacia coriacea subsp sericophylla,
Acacia kempeana,
Acacia murrayana,
Acacia victoriae,
Capparis mitchellii,
Capparis spinosa ssp. nummularia,

Carissa lanceolata,
Cyperus bulbosus,
Cucumis melo ssp. agrestis,
Marsdenia australis,
Rhyncharrhena linearis,
Santalum lanceolatum,
Solanum centrale &
Solanum cleistogamum

Five species (24%) chosen that were not endemic Pantharrpilenhe, although found in Inland Australia, included:-

Acacia colei
Ipomoea costata
Ipomoea polpha
Santalum acuminatum
Santalum spictatum
Solanum chippendalei

3.1.5 Cultivating Locally Provenanced Plant Varieties & Selection of Quality Plant Material

Locally provenanced plant species were chosen as being the most appropriate species to select for the trial with reference to their adaptation to the region and its climatic conditions and soil types, and with further reference to their association with the country and its people. Many of the plants were historically important as sources of food and water, were used for weapons and artefacts and used in ceremony or featured in mythology.

Seed stock was sourced from plants within the district with a focus on:-

- size of fruits;
- flavour;
- yields per plant, &
- health of species

With particular reference to *Solanum centrale* the seed stock collected from their natural habitat were propagated and grown. From the fruiting plants selected fruits were harvested and a second generation of plants from this seed stock has been propagated and grown on for Spring plantings.

3.1.6 Identifying Pre-planting Treatment Needs of Seed

A series of trials were undertaken to establish the most appropriate method for germinating different seed types gathered from the Pantharrpilenhe Excision. The focus was on establishing and utilising methods of treatment that do not require high technology and are easily achievable in remote locations.

Seed treatments included:-

- no treatment
- removing fleshly outer coverings and washing or leaching out any growth inhibitors
- niching and or soaking seeds in preheated water
- using “the fire method”

3.1.7 Propagating Plant Material by Vegetative Means

The focus of the trial to date has centred on propagating plants from seed stock. Some propagation trials were conducted using *Solanum centrale* and *Solanum chippendalei* by students at Centralian College and at the Alice Springs Desert Park.

3.1.8 Using Fire, Smoke and Water to Stimulate Germination

Fire is an important element within the arid zone regions with many plants having adapted to being able to withstand severe fires, while others rely on fire to stimulate germination when conditions are right. Equally other species have few fire evading adaptations.

“The vital role that fire plays in increasing the food supply of desert Aborigines is only now becoming appreciated. Many of the important Aboriginal food plants are the fire weeds, plants that require regular burning if they are to attain their maximum production..... I estimated the amount of fruit produced by a colony of Solanum centrale near Alice Springs to be 20kg during the first growth season after a bushfire. Three years later production had dropped to 0.26kg and five years later no fruit was produced, as most of the plants were dead.” (Latz 1995)

A number of native food producing plants are recognised as needing fire to stimulate germination. Of recent times “smoked water” has become the medium used in the nursery trade for stimulating germination of select species. Noting the regrow and germination of many species following fire and rain it was decided to simulate this situation in the nursery.

Seeds were sown on top of seed raising mix (3 parts coarse sand: 1 part sieved pine bark) and covered with 3-5mm of fine sand. The seed raising trays were then soaked from below until the soil mix was saturated. On top a small pyre was built using native foliage, bark, twigs and grasses. This pyre was lit for a period of from one to ten minutes with a view to establishing an appropriate burning time and then doused with a watering can until the fire was out. Unburnt debris was physically removed and the seed trays were then only lightly watered as required until germination.

3.2 Results and Discussion

3.2.1 Conducting a Local Flora Survey

A vegetation survey reveals the Quartzite hills are vegetated with spinifex, native grasses, small mallee eucalypts, acacias, sennas, *Indigofera leucotricha*, small numbers of White Cypress *Callitris glaucophylla*, Hakeas, the Ghost gum *Corymbia apparrerinja*, Whitewoods *Atalaya hemiglauca* and the Bloodwoods *Corymbia opaca*.

In the lower hills a variety of acacias including *Acacia victoriae*, *Acacia murrayana*, *Acacia ligulata* and *Acacia kempeana*, the Beefwood *Grevillea striata*, the Whitewoods *Atalaya hemiglauca*, *Senna artemisioides ssp artemisioides*, *Sennas sturtii* & *Senna freelingii*, *Indigofera leucotricha*, *Santalum lanceolatum* and a variety of Solanums can be found.

Within the lower valleys with their network of creeks, these water course/riverine communities feature River gums *Eucalyptus camaldulensis* and *Melaleuca glomerata* lining the banks, and, a diverse range of other species typical of the area.

Native food producing species included:-

<i>Abutilon leucopetalum</i>	<i>Capparis mitchellii</i> ,	<i>Hakea suberea</i>
<i>Acacia aneura</i>	<i>Capparis spinosa ssp. nummularia</i> ,	<i>Lysiana spp.</i>
<i>Acacia coriacea</i>	<i>Carissa lanceolata</i> ,	<i>Marsdenia australis</i> ,
<i>Acacia kempeana</i> ,	<i>Corimbia opaca</i> ,	<i>Portulaca oleracea</i>
<i>Acacia ligulata</i> ,	<i>Cyperus bulbosus</i> ,	<i>Rhyncharrhena linearis</i> ,
<i>Acacia murrayana</i>	<i>Cucumis melo ssp. agrestis</i>	<i>Santalum lanceolatum</i> ,
<i>Acacia victoriae</i>	<i>Enchylaena tomentosa</i>	<i>Solanum centrale</i> ,
<i>Amyema spp</i>	<i>Eucalyptus gamophylla</i>	<i>Solanum cleistogamum</i>
<i>Atalaya hemiglauca</i> ,	<i>Ficus platypoda var. minor</i>	<i>Solanum ellipticum</i>
<i>Calandrinia ssp</i>	<i>Grevillea striata</i> ,	

3.2.2 Monitoring the Flowering, Fruiting and Seeding of Local Native Food Species

A number of food producing species found on the Pantharrpilenhe Excision were monitored over a period to ascertain and assemble details about the plant species.

Other species were also monitored to varying degrees and it is from this information collected in the field, from local knowledge by the project participants, from written documentation and from the author's knowledge acquired over years that the plant profiles have been established. Listed below are the species that were monitored over a period of time, noting that the degree of monitoring varied for different species.

<i>Acacia aneura</i>	<i>Capparis mitchellii</i> ,	<i>Santalum lanceolatum</i> ,
<i>Acacia kempeana</i> ,	<i>Capparis spinosa ssp.</i>	<i>Solanum centrale</i>
<i>Acacia ligulata</i> ,	<i>Nummularia</i> ,	<i>Solanum ellipticum</i>
<i>Acacia murrayana</i>	<i>Carissa lanceolata</i> ,	
<i>Acacia victoriae</i>	<i>Marsdenia australis</i> ,	

A complete plant profile has been established on all plants that have been monitored in the wild, plants that have been cultivated in the trial and three species that are to be introduced into the trial cultivation plots.

Plant descriptions have been compiled, details of their ecology, flowering and yields have all been recorded as information became available. Added to this information data on propagation techniques and usage or potential usage of the plant species has also be included.

The collection of data over the past twelve months on native food species has seriously been affected by a lack of rain particularly at appropriate times, by an extremely cold winter with temperatures below minus six degrees and the impact of fire on some plant communities.

Rainfall over the past twelve months has been spasmodic and well below the average. In total 175.1 millimetres fell during 2002 over 25 days with the majority of rain falling over several days in two months, February and November.

Five months had no rain at all and of the 25 days when rain fell 11 days had less than 2 millimetres, 4 days less than 5 millimetres and 2 days less than 10 millimetres. Sixty percent of rainy days had less than 5 millimetres of rain and on only 3 occasions or 12% did the rainfall recorded exceed the average daily evaporation rate.

With the exception of one moderate fall on 24th May (12.2mm) and three other light falls on 26th March (0.3mm), 23rd May (1.3mm) and 17th September (2.8mm) it could literally be said it didn't rain from the end of February through to mid to late November. Lack of rain through these months seriously impacted on the recording of necessary data on the majority of food plants of the region.

Table Seven: Monthly Rainfall Details Arltunga 2002

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rainfall(mm)	12.8	44.2	0.3	0	13.5	0	0	0	2.8	0	99.2	2.3
No of Days	3	8	1	0	2	0	0	0	1	0	7	3
Evaporation Rate (mm)*	393.7	327.7	310	216	145.7	108	120.9	170.5	228	313.1	348	384.4

* Average Mean Evaporation rates are based on Alice Springs figures from the Bureau of Meteorology Northern Territory.

What was of significance was the November rains (99.2mm) and follow up falls in January 2003 (12.8mm) and February 2003 (44.2mm) which allowed for data to be recorded particularly with respect to *Capparis spinosa ssp. nummularia* (Wild passionfruit), *Capparis mitchellii* (Wild Orange) and *Marsdenia australis* (Bush banana).

Of equal significance were the minimum winter temperatures. In 2002 from June 10th until August 16th 37 nights recorded minimum temperatures of between zero degrees and minus 6.5 degrees. In June there were 10 nights of zero and below down to minus 5 degrees, in July 23 nights down to minus 6.5 degrees and 4 nights in early August down to minus 4.5.

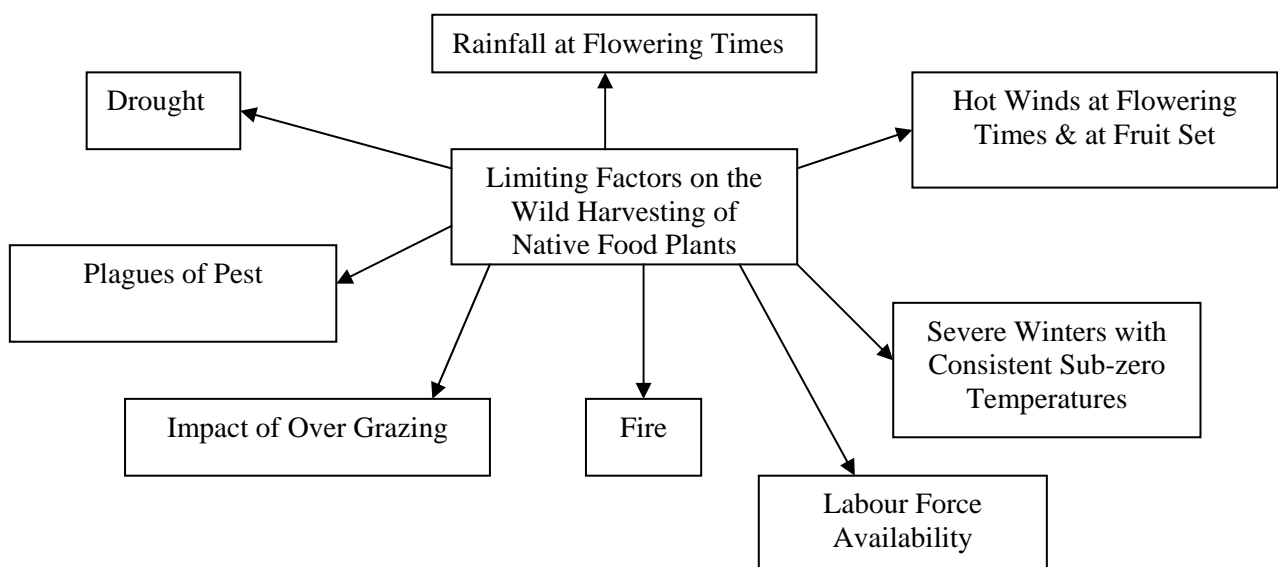
The *Capparis spinosa ssp. nummularia* (wild passionfruit), *Carissa lanceolata* (Conkleberry), *Atalaya hemiglauca* (Whitewoods) and the *Solanum* species were the worst affected by the frosts.

Carissa lanceolata and the *Solanum* species were the worst affected, in many cases being burnt to ground level. Those in protected locations were less affected. The *Capparis spinosa ssp. nummularia* have responded well to the limited summer rains and have been flowering since mid summer through to late autumn.

Of further impact on the monitoring of flowering, fruiting and yields of native food plants was the extent of country burnt out during mid to late 2002. While fire can with some species have a most positive impact on germination rates, growth and fruiting this is generally only after good rains that fall within the right seasons.

The ability to observe and detail information on native food plants in the wild and any reliance on gathering from the wild can be unreliable as months and even years of extended drought can impact enormously on the flora. Rainfall at the times of flowering which can with some species result in little or no seed or fruit set, severely cold winters, fire and even plagues of particular pests can result in unreliable observations and severely limit the potential for harvesting produce from the wild, sometimes for a number of years.

Figure Seven: Factors Affecting Wild Harvesting of Native Food Plants



3.2.3 OBSERVATION NOTES ON FIVE NATIVE FOOD SPECIES AT PANTHARRPILENHE:

Reference should be made to the observation notes immediately following and the plant profiles that have been compiled on all species under review for the purposes of this research project.

Capparis spinosa ssp. nummulria: (Arrutnenge)

Prolific throughout the Eastern MacDonnell Ranges, Ross River and Trepkina Gorge, Ambalindum and Love's Creek Station and the Pantharrpilenhe Excision.

Found largely along river/creek beds, river flats and on low calcareous hills under trees and generally in sheltered positions. Often found under *Eucalyptus camaldulensis* along creeks and creek/river levee banks. Shrubs in moderate to heavily shaded locations while healthy often had low flower numbers and few fruits. Shrubs in lightly shaded to open protected locations were consistently more prolific with fruiting yields.

Plants were found to flower from Spring through to late Autumn with moderate late Spring to Summer rains. It was not uncommon for plants to be budding, flowering, setting fruit and with mature fruits at the one time. Plants appear to respond well to pruning from grazing animals.

Mature plants under observation averaged 1metre high by 1.5 metres wide although plants to 1.5 metres in height and 3-4 metres wide could be found. On average 34 fruits were present per plant although it wasn't uncommon to find large plants with over 250 fruits present at the one time. With favourable conditions the plant will continue to produce fruit over an extended period.

Based on observations it isn't unreasonable to assume on average over 50 fruit per plant per season in the wild. Fruits vary in weight from 14.5 grams to 50grams, averaging 26.55 grams.

Fruits are best harvested just prior to ripening as once ripe the fruiting pod quickly opens and drops its entire contents in one movement. With the fruits ripening over an extended period of several months wild harvesting in large quantities may become difficult and more importantly the storing and preserving of the fruiting pulp becomes critical.

With pruning, and management of watering and fertilising needs, the level of production of plants in their natural environment could be significantly improved when plants are cultivated under production horticultural guidelines. Plants currently growing in the production horticulture trial are not mature enough to date to produce fruit.

Ants are very active on these shrubs at flowering and fruiting times.

Capparis mitchellii: (Artwakeye)

The extremely slow growing *Capparis mitchellii* or Bush Orange is common in woodland areas and near or on limestone hills. On Pantharrpilenhe these small trees are mostly found growing in large numbers immediately set back from river banks. They are also found growing on the side of small hills and in protected valleys in much smaller numbers, usually one or two often growing under larger trees such as *Acacia estrophiolata* (Ironwood) and *Corymbia opaca* (Bloodwood).

These trees appear to need the protective canopy of larger trees against severe frosts and from winds particularly during flowering. The trees found growing on the woodland plains without the protection of larger trees were noticeably smaller and often stunted in appearance. Those trees given protection tended to have better quality fruit.

Three sites were monitored, these being Slate Hole Bore on Love's Creek (16 trees), Lparlelheke on Love's Creek (38 trees) and New Bore (46 trees), a total of 100 trees. Tree health tended to vary considerably with many trees on the New Bore site being in rather poor condition.

A small percentage of trees flowered in mid September following light rains (2.8mm), with flowering occurring again in late November after quite heavy rains over several days. Fruiting occurred over an extended period from October through to mid February, although flowering overall was spasmodic with only a small percentage of trees producing fruit.

On one tree it is not uncommon to find flowers, juvenile and maturing fruits. Flowering can be extensive with 50 to 100 flowers at once.

Marsdenia australis: (Alangkwe)

Growing in numerous habitats this woody vine can be found climbing several metres over trees and shrubs, being found extensively along river/creek banks particularly on *Melaleuca glomerata* on Pantharrpilenhe. Two sites of 60 vines were monitored.

The *Marsdenia australis* is a popular food source for Aboriginal people with most parts of the plant being eaten. The young fruits are highly sought after, making recording of yields sometimes difficult. The flowers are also considered a delicacy.

The vines tend to race quickly to the top of supporting shrubs and trees. Under cultivation it is suggested that grape vine trellis be trialed to support these vines and that careful and regular pruning and training be undertaken as plants grow to induce lateral growth and ensure good trellis coverage.

Under observation it was discovered that these plants are very responsive to rain and quickly flower with fruits maturing in 4-6 weeks. With careful management of irrigation regimes it may be possible to induce fruiting several times a year. More work is required to explore this concept.

A mature vine in flower will be covered with blooms, producing varying numbers of fruit from 10 to 25 fruits at a time. Generally only 5-8 fruits appear to reach full maturity. Because the young fruit are highly sought after it is likely that many fruits are harvested well before maturity, explaining the reduced number of mature fruits recorded. Birds and wildlife including cattle may be responsible also for reduced numbers.

Rabbit numbers also appear to have a significant impact on plant presence with the plant now reasonably rare in the south-west corner of Central Australia. It has been suggested that over-grazing by rabbits have resulted in this situation. (Latz 1995)

Santalum lanceolatum: (Arrakweye)

Santalum lanceolatum grows extensively throughout Pantharrpilenhe in a range of habitats from protective valleys to low hill sides and on open woodland plains.

A small tree or large shrub 3-4 metres in height this plant has drooping bluish-green foliage and creamy-yellow flowers in clusters that produce small olive-like purple to black fruits 1.5 centimetres in size. Appreciably larger fruits are known to have been found on individual trees in Western Central Australia although none have been located on Pantharrpilenhe.

On five small sites 220 plants were located. Because the plant can reproduce by suckering it is not uncommon to find quite dense clusters of this plant. Many plants are only 1-1.5 metres in height.

The *santalum lanceolatum* appears to be an opportunistic plant and will quickly flower after favourable rains at most times of the year. Due to lack of rain over the past twelve months little flowering and fruiting has occurred, making recording of yields difficult. Summer rains have induced some colonies of plants to flower and fruit with the fruits maturing in May. On a healthy 3 metre plant 200-300 fruit have been observed, weighing between 2 to 3 kilograms. Numerous small shrubs bearing reasonable crops of fruit in May have not been assessed for yields. Plants without rain are commencing to flower in May.

The fruits are a favourite food for many birds, and a high percentage can also be damaged by insects including being stung by the native fruit fly. Up to 50% of fruit can be lost prior to harvesting. Under cultivation a pest management program may be critical.

Solanum Centrale: Akatyerre

The *Solanum centrale* were monitored on three particular sites with reference to several other sites as well. One site with 50 plants was located on a hill side facing north-west, and two other sites with 60-100 plants and 70-80 plants were on disturbed soil along side a track on Pantharrpilenhe. Plants within each group were a composite of newly emerging plants from suckers, young plants flowering with no fruits through to older plants that appeared past their prime with no evidence of flowering or fruiting.

The plant can grow from seed or by vigorously producing suckers thus often it is possible to find large clusters of plants in a small area. The establishment of plant colonies tend to rely on fire or disturbance of the ground, thus collections of plants are often found along Pantharrpilenhe road sides.

A hardy plant the *Solanum* is a clonal under-shrub around 30cm in height when growing naturally. It has soft foliage often with a rusty tinge and bright purple flowers.

The *Solanum centrale* can be found quite extensively on Pantharrpilenhe on the low hill tops and slopes, on spinifex sandplains and adjacent to Mulga communities. Plants are often found in patches of 15 to 50, although larger colonies can be located.

On the trial sites plants averaged between 20 and 30 centimetres in height although a small percentage were recorded as height as 50cm. Fruit can be carried on the plant for long periods and it isn't uncommon for a plant to be flowering, have young fruit, full size fruit and mature aged fruit that have dried on the plant. It's partly because of this that the plant is so highly valued. The fruits are highly nutritious.

This plant is most responsive to good rains flowering shortly after and quite quickly producing fruits that develop and mature over 2 – 3 months. Fruiting may occur throughout the warmer parts of the year. Spring flowering plants can be harvested by mid December with fruit being collected right through until the winter months.

Fruit production varied considerably between plants with older plants often with no or little fruit. On average 8-10 fruit could be found per plant. Fruit ranged in size from 1cm to 1.7cm in diameter. On the natural stands surveyed fruiting has generally been extremely poor over the past twelve months due to unfavourable conditions.

Most of the *solanums* died off over the winter months due to their susceptibility to frosts. Temperatures officially dropped to below minus 6 degrees in the winter of 2002 although ground temperatures were closer to minus 12 - 15 degrees.

Lack of spring rains resulted in poor regeneration with little vigorous regrowth over Spring. Noticeable growth wasn't recorded until December through to February following the summer rains, although, extreme summer temperatures without sustained moisture has resulted in limited fruit set. Small fruits to 1-1.25 cm were found in small numbers.

Solanum ellipticum (Awele-awele) commonly referred to as Native tomato, Potato bush and Wild Gooseberry can also be found growing reasonably extensively throughout the Pantharrpilenhe region. This variety of *Solanum* can be found in most habitats particularly on the lower foothills and lower hill slopes. The fruit of this variety is quite similar to *Solanum centrale* although the maturing fruit have quite distinctive purplish strips.

3.2.4 Basis for Selection of Species for the Research Project

Seventy-one percent (71.5%) of the species selected for the research project were species endemic to the region, with five plant types or twenty-four percent (24%) species that grow in Central Australia however not necessarily found on Pantharrpilenhe. One species comes from Western Australia (4.5%)

The underlying criteria used for selecting the species for trial rested on species that were endemic to Central Australia, species that have adapted well to arid zone conditions. The focus on acacia and solanum species rested largely with the fact that both species were important food sources for Aboriginal people in Central Australia and that market demand for both products is strong.

Wattle seed is in high demand with the product being able to be used in bread, pastry, biscuits, dampers, pancakes, icecream cones, mousses, icecreams, yoghurt, cream, flavourings and even in drinks with there being a caffeine free coffee made from wattle seed. Acacia seeds are highly nutritious and contain 26% protein, 26% available carbohydrate, 32% fibre and 9% fat (Brand and Maggiore 1992)

“Acacia seed in Australia was, and in some areas still is, used as a food source by Aboriginal people. It is now popular with the emergence of the bush foods industry as a new product with a variety of culinary applications. Wild populations are harvested for their seed, but the plants have potential as a commercial crop. It is hoped that the production of seed for food use is adopted by Aboriginal communities.” (Lister, Holford, Haigh & Morrison, 1996)

Acacia victoriae is the most sought after acacia species, although *A. colie* and *A. coriacea* are recognised as two Central Australian varieties having potential as alternatives to or complimenting *A. victoriae* (Morse 2003). *Acacia murrayana* is another variety also considered to have vast potential. (Latz 2002)

Acacia victoriae, *A. colie*, *A. coriacea* and *A. murrayana* are the main species that have been chosen for the Pantharrpilenhe project trial, chosen for their potential as a valued marketable food along with their various other potential secondary uses, particularly for Aboriginal people.

“Several species of Acacia indigenous to Central Australia are planted to revegetate or rehabilitate degraded land predominantly on Aboriginal communities throughout Central Australia. Species commonly used throughout the Pitjantjatjara Lands include A. victoriae, A. murrayana and A. kempeana. These are relatively fast growing species adapted to low rainfall and extreme temperatures and are planted to provide windbreaks, reduce erosion and to revegetate damaged sites. As the plants reach maturity they are often used for other purposes such as firewood and artefact manufacture (Last 1990) but less commonly for foods. Edible grubs (maku) are extracted from the roots of A. kempeana at any opportunity but seed is not generally collected for food (M. Last pers. Commun. 1995). The plants have potential as an informal crop, in that they possess a variety of uses which could form an additional source of food for the bushfoods industry.” (Lister, Holford, Haigh & Morrison, 1996)

Solanum centrale is another Central Australian native food plant that is an important food plant for Aboriginal people, grows throughout Central Australia and is in high demand by the Australia Native Foods Industry.

Solanum centrale is principally used as a flavouring or additive to a range of products now available through a range of Australian stores. Of recent times dried and fresh produce have been made available to the general public. *Solanum centrale* is also sold throughout community stores in Central Australia.

Much of the Bush tomato market is currently met by fruits collected from natural stands, from wild harvesting. The issues of reliability and quality and quantity of produce are most often raised in discussions on wild harvesting. A short history of the supply of wild harvested *Solanum centrale* from

Central Australia over the past decade illustrates the potential problems that may be inherent in an industry relying solely on produce harvested from the wild. The potential for developing both wild harvesting and production horticulture may resolve a range of issues that revolve around the current debate of wild harvesting versus production horticulture.

“Assuming produce is available in acceptable format the consistency of supply and quality must be guaranteed. This raises an industry requirement that must address the short term nature of wild harvesting and implement sound horticultural and management strategies which ensure adequate commercially grown supplies. Additionally, these supplies must represent consistent quality irrespective of climate induced variability, harvest, handling and transport issues. Note that the previously discussed situation of oversupply does not apply to major manufacturers who normally require product in 100 tonne lots in the designated form.” (Graham & Hart 1997)

While a strong focus of this trial has centred on *Solanum centrale*, this being the principal species in demand, considerable research needs to be conducted on other solanum species that may offer other opportunities within the Australian native foods industry. *Solanum chippendalei* and *Solanum cleistogamum* are two such species that have differing tastes and with *S. chippendalei* the fruits of this species are both sweet and have volume.

Being a relatively new industry the potential for utilising a wide range of native food producing species is considerable. Other species selected in this trial include *Capparis mitchellii*, *Capparis spinosa ssp. nummularia*, *Carissa lanceolata* and *Santalum lanceolatum* all are highly flavoured, many with considerable volume and have a range of potential uses within the preservative, flavouring and confectionary market. *Cucumis melo ssp. agrestis* along with *Cyperus bulbosus* have potential in the restaurant, flavouring and sauce industry while the *Ipomoea* species was once joked about as being the native foods industry answer to French fries, it certainly has potential.

3.2.5 Species Selected & Details on Each Species

The species selected were chosen to play differing roles to meet the project outcomes. Below is a summary of each species and how they are being or intend to be utilised.

Table Eight: Species Function within the Research Trial

Species	Currently under Cultivation	Currently being Propagated for Inclusion in the Trial Plantings	Species being Monitored in their Natural State	Species with Potential for Inclusion
<i>Acacia aneura</i>		YES	YES	
<i>Acacia colei</i>		YES		YES
<i>Acacia coriacea subsp sericophylla</i>		YES		YES
<i>Acacia kempeana</i>		YES	YES	YES
<i>Acacia murrayana</i>		YES	YES	
<i>Acacia victoriae</i>	YES	YES	YES	
<i>Capparis mitchellii</i>	YES	YES	YES	
<i>Capparis spinosa ssp nummularia</i>	YES	YES	YES	
<i>Carissa lanceolata</i>			YES	YES
<i>Cyperus bulbosus</i>	YES			
<i>Cucumis melo ssp. agrestis</i>	YES	YES		
<i>Ipomoea costata</i>	YES			
<i>Ipomoea polpha</i>	YES			
<i>Marsdenia australis</i>	YES	YES	YES	
<i>Rhyncharrhena linearis</i>	YES	YES		

Table Eight: Species Function within the Research Trial (Continued)

Species	Currently under Cultivation	Currently being Propagated for Inclusion in the Trial Plantings	Species being Monitored in their Natural State	Species with Potential for Inclusion
<i>Santalum accuminatum</i>	YES	YES		
<i>Santalum lanceolatum</i>		YES	YES	
<i>Santalum spicatum</i>	YES	YES		
<i>Solanum centrale</i>	YES	YES	YES	
<i>Solanum chippendalei</i>		YES		YES
<i>Solanum cleistogamum</i>		YES		

In Central Australia Aboriginal people have been utilising native plant species as a food and medicinal source for thousands of years. Over 140 plant species are currently used or have been used by aboriginal people of Central Australia. (Latz 1995)

The broad expanse of knowledge accumulated by Aboriginal people is evident in the diversity and quantity of plant species they use or have utilised and the various uses made of these plants.

The plant use made by aboriginal people can range from plants that form part of a staple diet, to seasonal plants as available and other species that are occasionally used for variety. (Latz 1995)

Reference should be made to the table below which rates the importance of plant species used for food. The rating is based on food type categories, noting that some species supply several food types.

Table Nine: Rating of Importance of Plant Species Used for Food

Food Type	Importance Rating				
	Staple	High	Moderate	Minor	Total
Fruits	5	5	13	5	28
Seeds	5	11	19	32	67
Tubers	3	1	2	6	12
Greens	-	-	5	4	9
Honey	-	1	3	14	18
Grubs	1	1	10	11	23
Lerps	-	3	4	2	9
Galls	-	2	-	-	2
Gums	-	-	2	11	13
Mushrooms	-	1	1	-	2
Total	14	25	59	85	

Information contained in the literature and table above is sourced from Desert Bush Tucker Identikit (1995) prepared by Peter Latz & Glenn Wightman, based upon the thesis "Bushfires and Bushtucker: Aborigines and plants in Central Australia" by Peter Latz.

NATIVE FOOD PLANT SPECIES UTILISED IN THE PROJECT

Introduction:

The range of endemic plants from Central Australia that have food potential is extensive. Listed below are the species being observed, monitored, grown or proposed to be cultivated in this project.

Table Ten: List of Project Plant Species

Botanical Name	Eastern Arreernte Plant Name	Family	Common Name
Acacia aneura	<i>artetye</i>	Mimosaceae	Mulga
Acacia colei		Mimosaceae	
Acacia coriacea subsp sericophylla	<i>aawenthe</i>	Mimosaceae	
Acacia kempeana	<i>atnyeme</i>	Mimosaceae	Witchetty bush
Acacia murrayana	<i>arnterre, arrelye</i>	Mimosaceae	Colony Wattle
Acacia victoriae	<i>arlepe</i>	Mimosaceae	Acacia bush, Victoria wattle
Capparis mitchellii	<i>artwakeye</i>	Capparaceae	Wild Orange
Capparis spinosa ssp. nummularia	<i>arrutnenge</i>	Capparaceae	Wild Passionfruit
Carissa lanceolata	<i>arrakweye, aperlape</i>	Apocynaceae	Conkerberry, Conkleberry
Cyperus bulbosus	<i>irreyakwerre, yalke</i>	Cyperaceae	Yalka, nalgoo, Onion grass
Cucumis melo ssp. agrestis		Cucurbitaceae	Native gooseberry, Native cucumber
Ipomoea costata	<i>anaty</i>	Convolvulaceae	Bush potato, Desert yam
Ipomoea polpha		Convolvulaceae	Native Yam
Marsdenia australis	<i>altyeye</i>	Asclepiadaceae	Bush banana
Rhyncharrhena linearis	<i>ngerake</i>	Asclepiadaceae	Bush bean
Santalum acuminatum	<i>pmerlpe, pmwerlpe</i>	Santalaceae	Quandong, Native peach
Santalum lanceolatum	<i>alkwe, ankweleye,</i>	Santalaceae	Wild plum
Santalum spicatum		Santalaceae	Sandalwood
Solanum centrale	<i>Akatyerre</i>	Solanaceae	Bush Raisin, Bush Tomato
Solanum chippendalei		Solanaceae	Wild or bush tomato
Solanum cleistogamum	<i>lyelyake, mwanyeme</i>	Solanaceae	Banana raisin

NATIVE FOOD PLANT SPECIES UTILISED IN THE PROJECT

While most of the species selected for trial occur naturally in the region several species from outside have been included. Of the 21 species included in this section 15 are under cultivation on the trial site with 10 of these having been grown from local seed. Five Central Australian species from outside the Pantharrpilenhe region have been propagated for planting out when ready. A number of the species are further being observed in their natural habitats.

The following section gives details on all plant species utilised in this trial. A brief description of the plant, its ecology, uses, propagation notes, cultivation notes, yields and economic opportunities are detailed in this section.

Acacia aneura

artetye

Mimosaceae

Mulga

Description:

A shrub or small tree quite variable in height from 4 – 10 metres with a spread of 3-6 metres. An often untidy tree it is characterised by its rough bark, variable foliage that can be small and needle-like to larger and broader from 1-17cm x 1-8mm (Urban, 1990), its flower spikes are cylindrical and its papery pods are short and flat. Relatively quick growing under cultivation this is one of the most drought resistant trees, it is however very susceptible to fire. The tree tends to grow in stands.

Ecology:

Found extensively throughout Central Australia in often quite solid stands. *“Can be found as a dominant species on loamy sands of plains, on rocky slopes, and in sandy soils of flat or undulating sandplains and sandhills.”* (Goddard, Kalotas 1985)

Uses:

Mulga seed and the mulga apple have been an important plant food for aborigines. The Mulga scale provided honey dew, a sweet sugary substance, that was sucked directly from the tree branches or when dissolved in water was consumed as a drink. Under the mulga could be found another popular food the honey ant that stored honey from the mulga scale. The wood of the mulga tree was also used extensively.

Propagation Notes:

Propagated easily from seed pre-soaked in water previously brought to the boil. Seed is soaked for a minimum of 12 hours or until seed swells and then sown into seed trays.

Cultivation Notes:

A hardy drought resistant tree that establishes quickly and can grow 2m per annum under irrigation.

Yields:

Flowering can occur at any time of the year after rain. In nature mostly out-of-season blooms fail to seed although with proper management and controlled watering it is believed this tree is capable of producing more than one crop annually. This has been evidenced in the wild when consistent rains have fallen at appropriate times. Large yields are produced if winter rains follow flowering.

Economic Opportunities:

As per most of the acacia species the national bush food industry is anxious to secure readily available supplies of acacia seed.

Acacia coleii**Mimosaceae**Description:

A large quick growing shrub variable in size from 2 - 7 metres, it has smooth bark, cylindrical yellow flower spikes, silvery broadish large leaves with small seeds produced in long narrow pods.

Ecology:

Species not generally common and found north of Alice Springs.

Uses:

A good producer of seed that is easily harvested and used as with other acacias. Seed is eaten, grubs can be harvested from the plant's roots and honey dew (a sweet sugary sticky substance) produced by scale infestations makes for a great drink.

Propagation Notes:

As per most acacias the seeds are best soaked in previously boiled water for at least 12 hours or until the seed has swollen.

Cultivation Notes:

As per most acacias they are quick growing and need minimal care once established. Controlled irrigation regimes will improve growth rates and maybe managed to improve flowering and yields as this tree particularly favours good conditions.

Yields:

Highly productive in good seasons.

Economic Opportunities:

As per many acacias, however this acacia is considered by some to have more potential than *Acacia victoriae*, a species mostly sought after by the Australian bush food industries. (Morse, 2003)

Acacia coriacea subsp sericophylla**aawenthe****Mimosaceae**Description:

A shrubby tree often mistaken from a distance for *Grevillea striata* this small 3-6 metre tree with a spread of 2-4 metres (APS, 2000) has pale corkish like bark, long greyish-blue/green foliage, pale yellow or cream globular flowers and long twisted seed pods constricted between the seeds (20cm x 1cm). A hardy drought tolerant tree that appears to response well after fire it regularly produces good quantities of seed.

Ecology:

Located mainly in deep sand dune country although not uncommon to be found in other habitats. Found mostly north and north west of Alice Springs.

Uses:

The seeds were much sought after by aboriginal people who ate them as a vegetable prior to maturity and also ground the mature seeds to produce "flour".

Propagation Notes:

As per most acacias, this particularly hard coated seed definitely needs to be soaked for an extended period (often well beyond 12 hours) in boiled water to break the outer seed casing. When seeds swell they should be removed and planted into seed trays. A slight nicking or sanding with sandpaper will also improve germination rates.

Cultivation Notes:

As per most acacias little special treatment is required. A pre-planting slow release or organic fertiliser can assist with early growth. Responds well to a well monitored water regime.

Yields:

A highly productive tree in cultivation and in the wild. Seeds mature in late spring through to early/mid summer.

Economic Opportunities:

As per many acacias, this is a highly productive tree with good yields. While the Australian Native Foods Industry mostly is seeking *Acacia victoriae* this tree is considered by some to have greater potential in the acacia seed industry. (Morse, 2003)

Acacia kempeana

atnyeme

Mimosaceae

Witchetty bush

Description:

A multi-stemmed spreading shrub or small tree to 4m high with broad grey-green foliage that forms a dense crown and golden flower spikes that produce papery flat pods approximately 7x1cm. A resilient quick growing plant that is capable of flowering many times in a year after rain.

Ecology:

The plant has a wide distribution throughout Central Australia found often on foothills and throughout limestone country.

Uses:

The seed of the witchetty bush is an important food that is generally roasted and ground and made into a paste. This shrub is more important for the large witchetty grubs that can be harvested from the plants roots.

Propagation Notes:

Easy to propagate from seed. Seed need to be pre-treated by placing in hot water initially and left for 24-48 hours prior to planting.

Cultivation Notes:

A quick growing, hardy shrub that will tolerate a range of soil conditions. When irrigated regularly it will grow 1m per year reaching full height in 3-4 years.

Yields:

Will flower and produce seed throughout the year with its main crop of seed occurring in late spring. Is quite a heavy cropping plant.

Economic Opportunities:

As with most acacias the seed has potential in the flour and bread industries. Because of its ability to flower after rain with controlled irrigation it is possible to induce flowering and seed production more than once a year.

Acacia murrayana

arnterre, arrelve

Mimosaceae Colony Wattle

Description:

A quick growing, short lived attractive acacia growing 2-6 metres tall with a spread of 2-7 metres. Characterised by its white bark, long narrow leaves and its bright golden yellow globular flowers it seeds prolifically flowering in spring and fruiting in spring and summer. One of a few species of acacia that consistently flower at the same time of the year.

Ecology:

This acacia grows predominantly in colonies mainly due to its suckering habit and is widespread found mostly south of Alice Springs in sandy country and along water courses and floodplains.

Uses:

As per many acacia species.

The mature seed was roasted and ground by aboriginal people and made into a paste, or pre maturity the green pods were eaten after lightly being roasted.

Early European settlers roasted and ground the seeds and used them as a coffee substitute. (Latz 1995).

Propagation Notes:

Easy to propagate from pre-soaked seeds.

Cultivation Notes:

An extremely quick growing acacia requiring little special attention.

Yields:

Having rather large seeds this high yielding plant is easily harvestable and capable of producing profitable yields in a relatively short period.

Economic Opportunities:

As per many acacias, it is considered by some to have huge potential as a main stream acacia species for the native foods industry.

“Acacia murrayana has more promise I believe than Acacia victoriae.” (Latz, 2001)

Acacia victoriae arlepe Mimosaceae Acacia bush, Victoria wattle

Description:

A quick growing, hardy, drought tolerant species that is only relatively short lived (10 - 12 years). A large shrub or small often untidy tree it has green branches often but not exclusively prickly, has variable but mostly bluish-green flat, narrow and pointed foliage and has pale yellow or creamy globular flowers. Flowering is reliable occurring in late winter to spring. The seed pods are papery, flat and oblong to approximately 6cm.

Ecology:

This species is common to all Central Australia and is found in many habitats. It is most common on river flats where it can be found in thickets and is particularly tolerant of quite adverse conditions. It is not uncommon to find it for example growing quite well in saline soils.

Uses:

An important food source for aboriginal peoples mostly due to its abundance and to its often later ripening period.

Propagation Notes:

A hard seed that if soaked in hot water for 24-36 hours prior to planting it will easily germinate.

Cultivation Notes:

This species like most of the acacias is easy to cultivate and grows well with little attention. A pre-planting organic or native slow release fertiliser will assist early growth. A managed watering regime at establishment stage will promote rapid early growth and will promote good yields once the plant matures.

Yields:

A high yielding species producing 6,000 seeds per kilogram and on average up to 10 kilograms of seed per tree.

Yields harvested in the wild can be variable as climatic conditions can seriously influence production.

Economic Opportunities:

The most sought after acacia seed variety with many tonnes being harvested from the wild annually in Central Australia for the Australian native foods industry.

It is anticipated that the local “wattle seed” bread industry in Alice Springs alone will utilise upwards of 1 tonne of wattle seed annually. (Morse 2003)

The potential for a reliable constant source of wattle seed is considerable.

Capparis spinosa ssp. nummularia arrutnenge Capparaceae Wild Passionfruit

Description:

A sprawling prickly shrub to 1-2m high with a spread of 1-2.5m with ovate leathery dull green foliage, spectacular delicate white flowers followed by oval shaped 4cm long green fruits that yellow when ripe. On ripening the fruits split and quickly drop their pith and seed. In favourable conditions the shrub flowers for an extended period from late spring through to late autumn with the first fruits ripening in summer.

Ecology:

Found growing along river beds and accompanying flats and near rocky hills in Central Australia being widespread in the Ambalindum, Ross River and Trepina Gorge region. Plants are often found growing close to stands of trees and in protected locations, possibly due to their intolerance of heavy frosts or because of their appeal to birds who may deposit the seed.

Uses:

Traditionally a sweet fruit eaten when ripe. Has potential for other uses.

Propagation Notes:

Easy to propagate from fresh seed that has all pulp removed from the seed. Germination usually within 14 days.

Cultivation Notes:

A hardy quick growing shrub that needs little attention once planted. A pre-planting organic or slow release native fertiliser should be applied at the planting stage. Best given some protection from frosts while young and best planted in a warm location.

The plant is susceptible to attack from the caterpillar of the white caper butterfly that can quickly strip the plant of all foliage. In cultivation possible preventative measures or a spray program may be required, although fortunately the plant recovers quickly from caterpillar attack and the foliage regrows rapidly.

Consideration could be given to fertilising with a side dressing of a high potassium fertiliser at flowering time to improve fruit quality and promote increased flowering.

Yields:

A productive shrub that can produce over 250 fruits in one fruiting, although on average plants produce 35 fruits. In favourable conditions the plant will continue flowering over an extended period with repeat fruiting from late spring through to late autumn. Fruits vary in size and weight averaging between 15grams and 50 grams per fruit.

Economic Opportunities:

Fruits can be harvested prior to ripening and allowed to then ripen thus providing some opportunity for fresh produce sales. The pith of the fruit is sweet and has considerable opportunities as a topping, flavouring and as an ingredient in preserves.

While the black seeds if bitten into are bitter tasting it is possible the seeds if crushed and ground may make for a condiment used to add taste to specific meals. Some experimentation along these lines has been undertaken Gael and Mike Quarmby.

Cyperus bulbosus irreyakwerre, yalke Cyperaceae Yalka, nalgoo, onion grass

Description:

An annual sedge plant with grass like stems 20-40cm high, the roots produce numerous bulbous small tubers approximately 10cm below the ground. An attractive plant with reddish-brown spiked flower heads. Fruits can be located immediately below the surface in cultivation.

Ecology:

Found throughout Central Australia, extensively found in sandy soils near water courses and salt lakes. Can be found growing in large numbers over extended areas

Uses:

One of the most important food plants in Central Australia, as the plant can be found in abundance in its habitat and is generally available for harvesting throughout the year. Can be eaten raw however often roasted.

Propagation Notes:

Easy to propagate. Direct seeding into beds or into individual tubes may be undertaken. Young seedlings are easy to handle and transplant.

Cultivation Notes:

May be planted closely together, they need consistent and reliable watering to promote good healthy growth.

Yields:

Plants reproduce rapidly in favourable conditions. There has been a high incidence of damage by birds when grown under cultivation. Yields have not been recorded.

“Because the plant is very abundant in favoured habitats..... it is often gathered in large amounts. The women sometimes dig a trench at the edge of a patch and then, working in a line, turn over the ground, picking out the bulbs as they go. They dig hectares of ground in this way, leaving the area with the appearance of a ploughed field.” (Latz 1995:158)

Ipomoea costata anaty Convolvulaceae Bush potato, Desert yam

Description:

This vine or shrub to 1.25m high when unsupported this plant can send out long tendrils that can cover 3 metres. These tendrils will also scale shrubs and trees to several metres. Large dark green, broad ovate foliage to 9 x 8cm this plant has brilliant large trumpet-like pink to purple flowers that have a bright red throat. The plant flowers in summer following rains and produces large edible tubers. Plants are frost tender.

Ecology:

Found usually on spinifex sand plains particularly to the north and north-west of Alice Springs.

Uses:

Bush potato is a staple food within its region, it is sweet tasting and quite juicy. It is similar in many ways to the sweet potato in appearance and nutrient value. A delicious tasting vegetable when sliced and fried and can be roasted or baked.

“Bush potato is sometimes traded between areas, especially into places where it does not naturally occur. Anmatyerr people sometimes wrap the tubers in Melaleuca bark, tied together with bark string,

and carry them down to Western Arrernte country, where they are exchanged for items such as rock pituri (*Nicotiana gossei*). (Latz 1995 : 215)

Propagation Notes:

Propagation from tubers, seed, cuttings and from pieces layered while attached to the parent plant. Seed can be planted untreated or after having been pre-soaked in hot water until they swell.

Cultivation Notes:

An easy plant to grow on mounds when given ample and reliable water. Problems with recovering the tubers exist as tubers can be more than a metre deep. Weed mat placed 50-75 cm below the plants has largely proved unreliable as many plant roots penetrate the weed mat with tubers growing below.

Building a large compost heap from 1-2m with branches, twigs, leaf litter, weeds, sand, soil and other suitable compostable material and planting on top has produced good results (White R 2002). Once plants die back or in late summer to autumn a bob-cat or front end loader is required to relocate the heap bucket by bucket at which time the tubers are removed. In spring the new mound is replanted. An effective method that relies on the availability of heavy machinery.

Hydroponics may offer an easy solution to the problem of recovering the tubers and research needs to be conducted into this method of production.

Yields:

As tubers are quite large returns per plant are reasonable. Plants are capable of producing on average 6-8 tubers with an average collective weight of at least 2 kilograms. Approximately 50% of tubers are recoverable in the top 50cm of soil with the other 50% up to 1-1.25m deep.

Economic Opportunities:

With its similarity to the sweet potato the Desert yam has considerable potential with good marketing, providing the economics of recovery can be improved.

As a chipped or sliced and fried product the *Ipomoea costata* could become the “French fries” of the Australian Native Foods Industry.

Considerable opportunities as a nursery plant for the home garden as a vine or low to medium shrub capable of adding brilliant flashes of colour to the native garden.

Ipomoea polpha

Convolvulaceae

Native Yam

Description:

Similar to *Ipomoea costata* this plant has large broad green foliage on tendrils spanning up to 4 metres. Less erect than *Ipomoea costata* this plant is an attractive, hardy ground cover plant with large trumpet-like pink flowers with a deep red throat. This plant produces large tubers averaging 1kg, although larger tubers to the size of a person’s head are not uncommon. (Latz 1995 : 217) Plants die off in early winter reappearing in spring.

Ecology:

A reasonably rare species in Central Australia this plant can be found “under Mulga in run-on areas”. (Latz 1995 : 217)

Uses:

Considered one of the best of the native yams this species is more nutritious than the yam from *Ipomoea costata*.

Propagation Notes:

Propagation from seed, tubers and by vegetative means from cuttings.

Cultivation Notes:

Similar to *Ipomoea costata* and like this species research needs to be conducted on various methods of cultivating this plant to improve efficiency with harvesting. The tubers of the *Ipomoea polpha* can generally be located closer to the surface in the 40 – 60cm zone.

Yields:

With average tubers weighing approximately 1kg an economically viable product once harvesting efficiency is improved.

Economic Opportunities:

As with *Ipomoea costata*.

Marsdenia australis altyeye Asclepiadaceae Bush banana

Description:

A woody vine often found climbing over trees and shrubs. Longish narrow green foliage up to 10cm the vine has creamy coloured bell shaped flowers in small cluster producing large tapering fruits to 10cm. A quick growing vine in favourable conditions.

Ecology:

Found throughout Central Australia in many differing habitats. Often found close to creek beds climbing over shrubs and small trees.

Uses:

An important aboriginal food with the sweet flowers and young fruits eaten fresh and considered a delicacy. Mature fruits are roasted, young foliage is eaten raw while mature leaves may be steamed.

Propagation Notes:

Grown from seed previously soaked in smoked water or using “the fire method”.

Cultivation Notes:

Best grown on strong trellis, requires frequent tip pruning to ensure even spread of vine over trellis. Vine tends to bolt to the top if allowed to grow unimpeded. Consideration could be given to cultivating the vine on grapevine trellising. Requires consistent watering and regular fertilising with organic fertilisers for best results.

Yields:

A highly productive vine will produce from 10-25 fruits per vine. Controlled irrigation may produce two or more crops per year. It is best planted on trellis 0.75 – 1.2m apart.

Opportunities:

Extremely popular food source when harvested while young. Potential as a delicacy for Australian Native Food restaurants and for distribution on Community stores.

The vine has considerable potential as a home garden plant.

Rhyncharrhena linearis ngerake Asclepiadaceae Bush bean

Description:

A quick growing vine or creeper that twins up over other plants. It has narrow hairless deep green foliage and small delicate greenish-yellow flowers. The fruits are long bean-like cylindrical pods up to 10 - 22cm long.

Ecology:

Found throughout Central Australia in a range of habitats, often found on small hills. Common to find scaling Mulga trees.

Uses:

Flowers, foliage and young seed pods are eaten.

Propagation Notes:

Grown from seed with no prior treatment required. Although untried, smoked water may improve germination rates.

Cultivation Notes:

It is a quick growing vine that needs support. Maybe grown in natural stands on mature trees or grown on constructed trellis. Frequent tip pruning is required to prevent plant racing to the top of the trellis.

Yields:

Yields are high, although plants under cultivation have yet to be harvested.

Santalum acuminatum *pmerlpe, pmwerlpe* **Santalaceae** **Quandong, Native peach**

Description:

A shrub or small tree variable in size from 4-6 metres in height. Foliage is drooping in habit, light green to grey-green in colour and somewhat leathery in appearance. Small greenish sometimes insignificant flowers in clusters the tree is more noted for its brightly coloured red fruits to 2-3cm. Flowering can occur while fruits are ripening providing an attractive contrast.

Ecology:

Found only south and south-west of Alice Springs mainly in sandy spinifex country often found near water courses or in protected locations sometimes on stony soils.

Uses:

A popular traditional food within its region, the fleshy fruit can be eaten fresh, dried or when reconstituted with water. Fruit is rich in Vitamin C and the kernel is highly nutritious having 25% protein and 70% oil content. (Grant & Buttrose 1978)

As a fresh fruit, in pies, sauces or jams this fruit has numerous uses that are being realised today as a popular native food product.

Propagation Notes:

The Quandong can be direct seeded or seedlings may be cultivated in the nursery situation. When direct seeding at least 5 seeds should be planted on the outer watering ring of existing vegetation. With irrigation seedlings will emerge in the first year, although germination can be stimulated by good rain falls.

In the nursery special propagation techniques are required. Seeds should be sterilised by placing in 1 part bleach 9 parts water for an hour. Seeds should then be washed in distilled water and placed in a small to medium zip-top plastic bag half filled with moistened vermiculite. Bags should be stored in an environment with a constant temperature just over 17 - 22 degrees.

Germination may occur within 3 weeks in favourable conditions although seeds will continue to germinate for up to 9 months. On germination seedlings should be potted up with a host plant, allowed to establish prior to planting out in the field.

A parasitic plant the Quandong relies on a host plant to survive. In the nursery *Myoporum parvifolium*, *Eremophila* varieties, low growing acacias and a range of grasses can be used as host plants.

Cultivation Notes:

A reliable water supply and early protection over the first summer is necessary for successful strike rates for both direct seeding and transplants. Care needs to be given when planting and in the first

year. Best planting results have occurred when planting is undertaken in early spring. Problems can occur with root rot if over irrigated.

Yields:

A highly productive tree. Reference should be made to a range of literature available on the Quandong.

Economic Opportunities:

Being realised with many Quandong orchards having been developed particularly in South Australia.

Santalum lanceolatum *alkwe, ankweleye, arrankweye* Santalaceae Wild plum

Description:

An attractive shrub or small tree 2-3.5m high with drooping grey-green to bluish-green rather leathery like foliage. The flowers are small cream bells 6-8mm long producing fleshy oval 1cm diameter fruits that ripen to purple to almost black in colour.

Ecology:

Found throughout Central Australia in a wide range of habitats. Often found in small colonies along water courses, at the base of rocky outcrops where water run offs. Also on sand hills and sand plains. (Goddard & Kalotas 1985)

Uses:

Although producing only small fruits the plum bush is an important food in the region as it has a pleasant taste, is widely distributed, produces good quantities of fruit and can be eaten fresh or dried. Large fruit have been observed on fruit near Santa Teresa and west near Gosse's Bluff.

Propagation Notes:

Propagated from seed the Plum bush is a semi-parasitic plant and requires a host plant when grown in the nursery and in the field.

Cultivation Notes:

Sometimes slow growing this attractive shrub needs a host plant, a regular watering regime and can be used as a good wind break plant.

Yields:

Highly productive in good seasons.

Economic Opportunities:

In conserves, sauces and as a flavouring or fruit variety in glazed collections of native fruits.

The wood is like sandalwood and was once exported for its perfumed wood and oil The oil can be hard to extract and currently is deemed not viable commercially.

Solanum centrale *Akatyerre* Solanaceae Bush Raisin or Bush Tomato

Description:

A small sub-shrub 30-50cm high and because of its ability to sucker one original plant can eventually cover several square metres. Leaves are soft, ovate-oblong (3-6cm), 1-2 cm wide, covered in downy yellow/rusty hairs, foliage colour can vary from grey/bluish green through to green with a yellow/orange tinge. Flowers are purple followed by small often sticky yellow fruits that can with age develop a deep chocolate colour. Fruits can hang on the plants for months. Plants tend to flower following rain.

Ecology:

Found throughout Central Australia in spinifex sand plains, sand dunes and Mulga areas. Fire appears an important ingredient in ensuring its continued regrowth. They respond well to disturbed soils.

Severe frosts will kill the plant to ground level, although with favourable conditions the plants re-emerge in Spring.

Uses:

Possible the most significant food plant in Central Australia being quite nutritious whether eaten fresh or when dry. Fruit flavour can vary considerably from being quite bitter to rather sweet in taste.

Propagation Notes:

With no treatment of seed extremely poor germination rates (1-2%). Successful propagation from seed relies on using “smoked water” or “the fire method”. Seeding propagation trays and then burning a small fire on the tray using native grasses, bark, twigs and leaves for a limited period promotes high germination (68 -75%). See section on “the fire method” for more details.

Propagation from vegetative material has proved difficult with damping off a major problem. More experimenting with cultivating cutting material needs to be undertaken. A need exists for the nursery industry to develop and make available in large numbers particular cultivars.

Mike Quarmby from Reidy Creek Nursery in South Australia appears to be taking up the challenge and producing economically priced plant units and making them available for aboriginal communities.

Cultivation Notes:

Require good drainage promoted by cultivation on raised beds. Drip irrigation using in-line emitters is the preferred method of irrigation. Watering should be consistent particularly in the main growth period from mid spring onwards and over the hot summer months to promote good fruit production.

Yields:

Production trials in Central Australia are producing 50 – 100 fruits per plant, with cropping much improved in the second year. Trials in South Australia project 20-30,000 plants per hectare producing 7 to 8 tonnes. (Quarmby, 2001)

Produce collected from the wild makes up much of the current market, with climatic conditions impacting seriously on the volume collected annually.

For example, from Utopia in Central Australia in 1997 some 1.4 tonnes of Solanums were collected in a bumper year, in 1999 drought resulted in no harvesting and in 2000 it rained for extended periods of the year with only 200 kilograms being harvested. (Horner 2001)

Economic Opportunities:

Fresh fruit and dried fruit sales for local market, production for interstate markets for sauces, chutneys, etc, sale of seed for bush food and garden enthusiasts and souvenir or memento sales to interstate and overseas visitors.

As a small foreground plant with attractive foliage and blooms this species has considerable potential as a nursery plant.

Opportunities exist for both wild harvest and cultivation production for larger interstate and international market.

Solanum chippendalei

Solanaceae

Wild or bush tomato

Description:

An attractive plant variable in height from 25cm to 1.25m with soft, ovate grey-green to grey-blue foliage. Flowers range from lilac to purple and are followed by large globular fruits 3cm in diameter that are coloured yellow when ripe. Plant is heavily covered in hairs and fine sharp needles to 1cm.

Ecology:

Occurs north and north-west of Alice Springs on sand plains and hill slopes. Fruit produced following good rains. Fires and drought appear essential in promoting plant abundance in the wild. (Latz 1995)

Uses:

A large fruit easily harvested, a valuable food source in its region. Only the outer rind is eaten as seeds are extremely bitter. The fruit has a mild pleasant tropical/fruit salad flavour, is high in vitamin C and has a long shelf life.

Propagation Notes:

Smoked water or using “the fire method” with best results from propagation of seed undertaken in late summer. Producing plants by way of vegetative means has proved difficult and needs more research.

Cultivation Notes:

Similar to *Solanum centrale*

Yields:

Early indications suggest 20-30 fruits per plant, totalling around 1 kg per annum per plant. More research is required.

Economic Opportunities:

Being a large fruit with volume and having a long shelf life when fresh this fruit appears to have potential as a fresh fruit. Possibilities in bottling or glazing this fruit on its own or with other bush foods need to be explored.

Solanum cleistogamum *Iyelyake, mwanymeme* Solanaceae Banana raisin

Description:

A low spreading shrub 25-30cm high with soft, greyish/blue foliage-green foliage, small insignificant flowers bearing small yellow fruit which has a distinct banana flavour. It is definitely the sweetest of the Solanums.

Ecology:

Reasonably difficult to find although distributed right throughout Central Australia. Can be located in spinifex sand plains, within some Mulga stands and following some creeks.

Uses:

A favoured fruit because of its sweetness and banana like flavour, it is quite high in nutritional value. Best eaten when freshly picked either just prior to ripening or when ripe.

Propagation Notes:

Propagation from seed using smoked water or “the fire method.” This variety is one of the few Solanums that offer encouraging results when using vegetative material to produce true to type plant varieties.

Cultivation Notes:

A low growing solanum needing good drainage and a regular watering regime.

Yields:

Generally a small fruit produced in considerable numbers in clusters. Yields are unknown to date.

Opportunities:

Because of its palatability and sweetness this variety of solanum is deemed to have considerable potential although its short shelf life may pose problems. Harvesting, handling and storage appear to be more critical with this variety of solanum. As a fresh fruit and as part of a composite of native fruits this species appears to have great potential.

3.2.6 Cultivating Locally Provenanced Plant Varieties and Selection of Quality Plant Material

With a lack of available Central Australian native food species plants from local nurseries and the desire to use where able locally provenanced stock most of the plant material has been propagated from seed sourced from Pantharrpilenhe.

In selecting seed the size of the fruits, their flavour, yields per plant and the health of the species formed the basis for selection. While recognising the variability of stock from seed can vary enormously there were few options.

In the longer term it is anticipated that as plants under cultivation demonstrate their capacity re quality of fruits and yields vegetative material will be collected and propagated reproducing truly the characteristics of the parent plant. Extensive experimentation will be required to refine propagation techniques using vegetative material from a range of Central Australian native food species.

Complimenting this, selection of fruits of the *Solanum centrale* will be made on fruit size and flavour and successive generations will be cultivated. A second generation of *Solanum centrale* have recently been germinated ready for planting in the spring of 2003.

3.2.7 Identifying Pre-planting Treatment Needs of Seed

Consistent with promoting independence, furthering the individual skills of the participants and allowing people in remote regions to generate their own plant material for their enterprises seed treatment trials were conducted.

Seed treatments included no treatment, removing fleshy outer coverings and washing or leaching out of any growth inhibitors, planting fresh seed, niching and/or soaking seeds in preheated water and using “the fire method.”

A variety of treatments are required to stimulate germination for many Central Australian plant species, and this is no different for many of the native food producing species. Many species have adapted various responses to climatic conditions, grazing, self preservation, the need to limit competition, and to fire. An understanding of each plant species generally provides the necessary clues as to which methods of propagation should be initiated.

Seeds Requiring Removal of Fleshy Pulp:

The freshly fruits *Capparis mitchelli*, *Capparis spinosa* ssp. *nummularia*, *Carissa lanceolata* and *Cucumis melo* ssp. *agrestis* all require the fleshy fruit pulp to be separated and removed from the seeds. Fruit should be collected once fully ripe and using a sieve the seeds require washing as pulp is removed by rubbing the pulp and seeds over the sieve. Seeds should be dried for 2-7 days and then planted with no extra treatment.

While trials to date have not been undertaken antidotal evidence would suggest that *Capparis mitchelli*, *Capparis spinosa* ssp. *nummularia* and *Carissa lanceolata* may respond well to direct seeding in spring. Further research on direct seeding needs to be undertaken.

Capparis spinosa ssp. *nummularia* germinates readily in the nursery however problems often arise when these plants are grown-on in the nursery. Low phosphorous fertilisers should only be used in potting mixes for this plant.

Growth inhibitors in the fruit and problems with pests and fungal diseases can be a problem if seeds aren't treated immediately after harvesting.

Seeds Requiring No Treatment Prior to Planting:

Cyperus bulbosus, *Cucumis melo*, *Ipomoea costata*, *Ipomoea polpha*, *Marsdenia australis* and *Rhyncharrhena linearis* all will germinate quite readily in the nursery with no special treatment. With the latter two it is critical that seed is fully mature prior to harvesting.

Ipomoea costata and *Ipomoea polpha* benefit from seeds being nicked and/or pre-treated in previously boiled water. Seeds should be soaked from 24 to 96 hours and once swollen removed and planted into tubes, pots or directly into the ground. Seeds will germinate with no treatment.

Soaking Seed in Hot Water Prior to Seeding:

Many extremely hard shelled seeds common in Central Australia should be placed into hot water, that has been brought to the boil, and allowed to soak to stimulate germination. Seeds should be left until swollen before being removed and planted into tubes or pots in the nursery. This is particularly so for acacia and senna species. *Acacia aneura*, *Acacia colei*, *Acacia coriacea*, *Acacia kempeana*, *Acacia murrayana* and *Acacia victoriae* all require soaking to stimulate germination.

Using “The Fire Method” to Stimulate Germination:

Grevilleas, hakeas and solanums are all species that require seed to be either soaked in “smoked water” or treated to “The Fire Method.”

The concept of “Smoked water” evolved out of Kings Park in Perth where it was found a range of species responded remarkably to being treated with water that has had smoked permeated through it. “Smoked water” can be purchased as a commercial product or be manufactured locally. Local production requires a reasonable amount of infrastructure, knowledge and skill.

Trials undertaken with the solanum species, using a simple fire/smoking technique, have proved highly reliable. This method require no infrastructure or purchasing of “smoked water” and requires little expertise. *Solanum centrale* and *Solanum chippendalei* all achieved high germination rates when treated to “The Fire Method”. See following section for complete details.

Germinating Seed in Vermiculite:

The santalum species require a degree of specialised treatment to stimulate germination. The santalum will germinate when direct seeded however, particularly with *Santalum accuminatum*, germination can take longer than twelve months, and often only after extended deep soaking rains.

Santalum species seed should be soaked in a 1 part bleach to 9 parts water mix for at least one hour, then rinsed in distilled water and placed into a mix of moistened vermiculite in a zip top plastic bag. Seed should only be moved with a sterile implement, the use of hands can contaminate and cause fungal problems.

The sealed bags, with most air removed, should be placed into a cool location with a controlled room temperature of 17 –22 degrees for best germination. The moistened vermiculite may be treated with an appropriate fungicide to limit possible problems of seed rotting.

As a second option, simply placing seed in moist vermiculite in a zip top plastic bag will result in germination, provided the bags are placed in a cool location, however higher loss rates due to seed rotting are likely.

Germination can occur within 3-4 weeks, although it isn’t uncommon for seeds to progressively germinate over an extended period. Using this method a percentage of seeds may still take up to nine months to germinate. Germination is best attempted in early to late Spring or in mid to late Autumn.

Santalum accuminatum, *Santalum lanceolatum* and *Santalum spicatum* have all been germinated using the first option. Being semi-parasitic or parasitic, these plants all require a host plant whether being grown-on in the nursery or when planted out into the ground. Myoporum, eremophilas and acacias have all proved reliable hosts. A range of native grasses, kikuyu and lucerne may also be used.

Santalum lanceolatum germinates relatively easily compared to the other mentioned santalum species. In all three cases direct seeding once seeds have commenced germination is recommended in spring.

Table Eleven: Treatment Methods for Stimulating Germination of Native Plant Food Species

Species	Preferred Method of Treating Seed to Stimulate Germination					
	Removing Fleshy Pulp Required	No Pre-Planting Treatment Required	Planting Freshly Dried Seed	Soaking in Hot Water	Using “The Fire Method”	Germinating in Vermiculite
<i>Acacia aneura</i>				YES		
<i>Acacia colei</i>				YES		
<i>Acacia coriacea</i>				YES		
<i>Acacia kempeana</i>				YES		
<i>Acacia murrayana</i>				YES		
<i>Acacia victoriae</i>				YES		
<i>Capparis mitchelli</i>	YES		YES			
<i>Capparis spinosa</i>	YES		YES			
<i>Carissa lanceolata</i>	YES *					
<i>Cyperus bulbosus</i>		YES				
<i>Cucumis melo</i>	YES					
<i>Ipomoea costata</i>		YES		YES		
<i>Ipomoea polpha</i>		YES		YES		
<i>Marsdenia australis</i>		YES			YES	
<i>Rhyncharrhena linearis</i>		YES				
<i>Santalum accuminatum</i>						YES
<i>Santalum lanceolatum</i>	YES					YES
<i>Santalum spicatum</i>					YES	YES
<i>Solanum centrale</i>					YES	
<i>Solanum cleistogamum</i>					YES	
<i>Solanum chippendalei</i>					YES	

* With *Carissa lanceolata*, once having removed the fruiting pulp the seed casing should be crushed gently to remove the seeds inside.

3.2.8 Propagating Plant Material by Vegetative Means

Understanding the necessity to identify quality plants with large, pleasant tasting, high yielding potential and reproducing these plants by vegetative propagation means, trials were undertaken using *Solanum centrale* and *Solanum chippendalei*. These trials were conducted in two vastly different nurseries, one with sophisticated technology and the other with little infrastructure.

In both instances limited success was experienced. To improve quality and reliability of yield and produce, knowledge and techniques must be acquired and developed to allow for high propagation success rates when using vegetative material. Further research is definitely required in this area.

3.2.9 Using Fire, Smoke and Water to Stimulate Germination

Fire is an important element within the arid zone regions with many plants having adapted to being able to withstand severe fires, while others rely on fire to stimulate germination under favourable conditions. A number of native food producing plants are recognised as needing fire to stimulate germination. Noting the regrow and germination of many species following fire and rain it was decided to simulate this situation in the nursery.

Seeds were sown on top of or planted into seed raising mix (3-5 parts coarse sand: 1 part sieved pine bark) and covered with 3-5 mm of fine sand, depending on the size of the seed. Seed raising trays were then soaked from below until the soil mix was saturated.

On top a small pyre was built using native foliage, bark, twigs and grasses and subsequently lit for an optimum period of 3.5 - 4 minutes. Trays were then doused with a watering can until the fire was out. Unburnt debris was physically removed and the seed trays were then only lightly watered as required until germination.

A range of trials were conducted where the fires were burnt for periods ranging from 1 - 10 minutes and germination rates were observed. With an moderately intense fire best germination occurred where fires burnt for 3.5 – 4 minutes. For slower burning fires 4-4.5 minutes was required. Where the fires were burnt for periods less than 3 minutes and over 4.5 minutes the germination rates fell away dramatically.

Controls with no treatment for *Solanum centrale* had a germination success rate of 1-2% after 30 days while “The Fire Method” had germination rates as high as 78% after 15-30 days. This was equally similar with *Solanum chippendalei*. The viability of the seed had not been tested and to date no comparative analysis has been completed using “The Fire Method” as against using smoked water. This comparative analysis will need to be undertaken.

4. Cultivation Techniques & Management Treatments of Native Food Species

With the development of a native foods production horticulture enterprise at Pantharrpilenhe, different cultivation techniques and treatments for the management of the native food species were undertaken.

4.1 Methodology and Materials

4.1.1 Utilising a Variety of Horticultural Techniques

Managing a horticultural enterprise in an arid zone requires utilising a range of conventional horticultural techniques and other specifically developed techniques that have been designed in response to a range of factors that can impact on horticultural enterprises in remote locations.

Factors Affecting the Design and Construction of the Enterprise:

Techniques adopted need to be mindful of:-

- | | |
|--|--|
| i) the extreme temperature variations | vi) issues of salinity |
| ii) high evaporation rates | vii) water quality and quantity |
| iii) low annual rainfall | viii) the high cost of freight |
| iv) an unreliable and often erratic rainfall | ix) distances of travel |
| v) alkaline soils | x) the nature of the crops of production |

The Importance of Technical Advice:

Critical to the setting up of a native foods production enterprise is site selection and a full analysis of the area to be cultivated. Issues of soil type, alkalinity, salinity and weeds need to be fully assessed and appropriate management practices established accordingly.

Technical support is critical at this stage in terms of undertaking necessary assessments, tests, etc and being able to fully analyse data received and implement necessary recommendations.

Infrastructure Development:

Once an assessment was undertaken and results analysed the infrastructure had to be established.

Infrastructure development involved:-

- Relocating two tanks to a hill top to hold 20,000 litres of water from the bore (issues of flow/pressure) and one tank(5,000 litres) to capture rainwater from the main residence,
- establishing a back-up system at the bore to ensure continuity of water supply,
- burying of mains pipeline from horticultural plot to the bore (pipeline partly buried, awaiting end of mustering season for Ambalindum Station staff and machinery to complete the task) ,
- fencing of the area to be cultivated,
- ground preparation,
- establishing an irrigation system with the appropriate infrastructure including filtration and allowing for fertigation,
- constructing two shade houses to hold seedlings and trial plants under shade,
- ensure adequate storage facilities were available for storage of fertilisers, chemicals, etc.

Layout of Garden Plots within the Horticultural Plot:

The garden plots have been laid out with a strong focus on:-

- being able to capture run-off water from rains,
- providing improved drainage
- access to beds for ease of management, and,
- harvesting considerations.

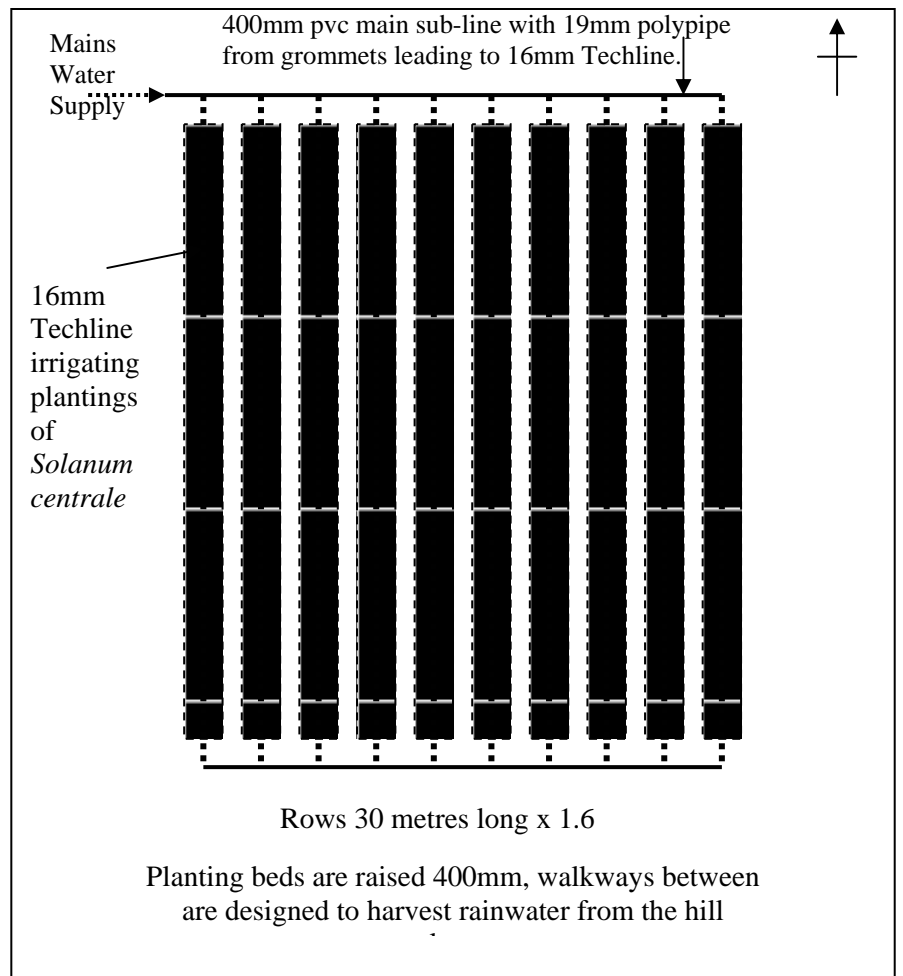
Map Three: Design Layout for Initial *Solanum centrale* Plot

The first trial plot was constructed following traditional horticultural practices. The earth was mounded using a bob-cat with rows 30 metres long at 1.6 metre spacings.

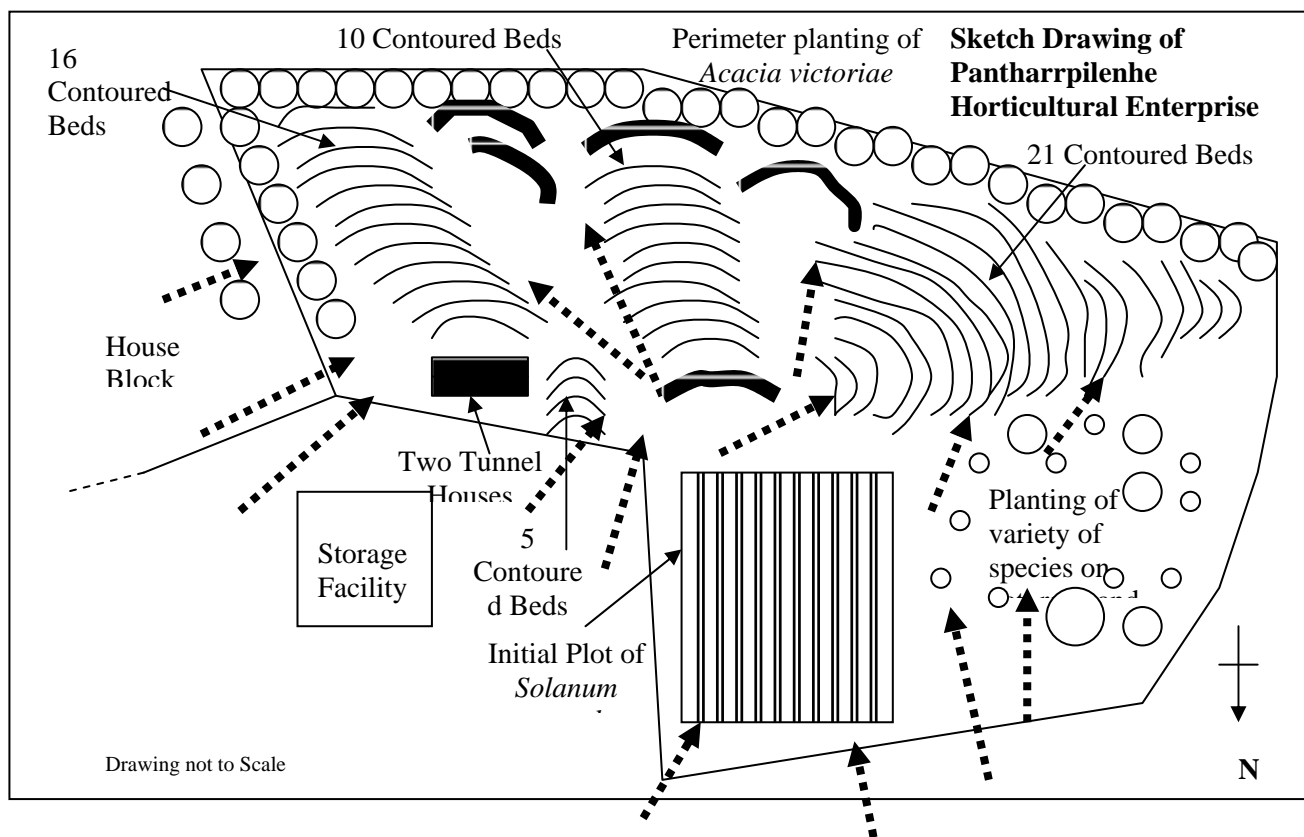
A pre-planting fertiliser was physically hand hoed into the ground at a depth of 100mm.

Solanum centrale seedlings were planted manually at 50cm spacings.

The plantings are irrigated by 16mm techline, a irrigation type with in-line emitters designed to flow 2.3 litres per hour at 100kpa. The emitters are at 35cm spacing.



Map Four: Layout of Beds with a Strong Focus on Water Harvesting:



<p>LEGEND:</p> <p>Water Flow on Hill Slope </p> <p>Contour Lines of Curved Planting Rows Designed to Harvest Rainfall Run-off </p>	Natural Trees & Shrubs	Contoured Planting Beds Planted 2002
	<i>Acacia victoriae</i>	Tunnel Houses
	Citrus varieties	

Because of the aspect, the slope of the hillside on which the horticultural plot has been located, water harvesting has been given priority. Under normal circumstances most of any rainfall on the hill slope would be lost through run-off into the valley below.

The intent has been to maximise the benefits of water harvesting in an arid environment where normal reliance is on often quite brackish bore water.

Establishing Wind Protection:

To reduce the impact of hot drying winds and to accommodate into the project a major acacia species a perimeter planting of *Acacia victoriae* has been undertaken. The acacias are irrigated by 4 litre per hour pressure compensating drippers.

Further exterior plants with *Acacia colei*, *Acacia murrayana* and *Acacia coriancea sub sp sericophylla* are proposed, with the aforementioned species currently being grown on in a nursery.

Planting with Native Stands:

Trial plantings of *Cucumis melo ssp. agrestis*, *Ipomea costata*, *Ipomea polpha*, *Marsdenia australis* and *Rhyncharrhena linearis* were undertaken next to *Acacia estrophiolata* and *Acacia victoriae*.

Being able to using existing vegetation as a source of shade protection and support, and, to explore the inter-relationship of native food species with other species, prompted these trials.

Shade & Protection:

Summer sun intensity and winter frosts can impact considerably on plant growth and yields. Limited trials have been undertaken utilising the shade of the natural vegetation stands and some species are being trialed under shade cloth.

Mulching:

Limited mulching trials have been undertaken using animal manures and leaf litter from native species on site.

Soil Conditioning & Fertilising:

Gypsum at the rate of 0.5 kilograms per metre of row was applied at the pre-planting stage. A second application of gypsum at the rate of 0.5 kilograms per metre of row has been applied to the surface of all rows under cultivation.

A pre-planting fertiliser was applied to the planting beds prior to planting. For the *Solanum centrale* a light application of Sulphate of ammonia and Dynamic Lifter at the rate of 100 grams per linear metre were applied.

The *Solanum centrale* have since been left unfertilised to assess growth rates and yields with minimal intervention.

It is proposed that a regular fertilising regime will be established in the Spring of 2003 on sections of the initial solanum plot to assess the impact of different fertilisers on growth rates and yields.

4.1.3 Cultivating Native Food Plants with Existing Native Plant Stands

Trial plantings of *Cucumis melo ssp. agrestis*, *Ipomea costata*, *Ipomea polpa*, *Marsdenia australis* and *Rhyncharrhena linearis* were established under a natural stand of *Acacia estrophiolata* and *Acacia victoriae*.

The plantings are irrigated by drip irrigation by pressure compensating drippers at 4 litres per hour.

Minimal intervention, aside from irrigating has taken place. Some animal (cow and kangaroo) manures and leaf litter for mulch has been applied to some plantings.

4.1.3 A Focus on Drip Irrigation

Two different irrigation methods have been established on the trial site. The irrigation systems are fully automated to ensure regular watering can be undertaken independent of the participants.

All plants are irrigated by either:-

- a drip irrigation system using 4 litre per hour pressure compensating drippers or
- by 16mm Techline which has internal line emitters at 35cm spacings with discharge at 2.3 litres per hour.

Aside from at establishment stage the focus on irrigating has been to provide long deep waterings for extended periods to minimise potential problems of salinity, to promote deep root growth and to grow drought tolerant plants.

4.1.4 Introducing Water Harvesting into the Project

With limited, erratic rainfall that can fall in large volumes over short periods water harvesting principles underlie the design elements of the project. Reference should be made to Map Four:

“Layout of Beds with a Strong Focus on Water Harvesting” in section 4.1.1. Issues of potential salinity problems from irrigation re-enforce the need to introduce water harvesting into the project.

4.2 Results and Discussion

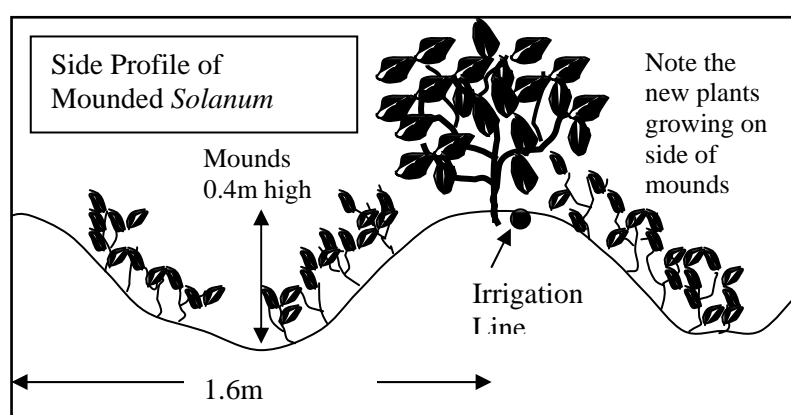
4.2.1 Utilising a Variety of Horticultural Techniques

Design Layout for Initial *Solanum centrale* Plot & Production Outcomes:

The layout for the initial planting of *Solanum centrale* was a rectangular plot with ten rows 30 metres long with 1.6 spacings between rows, with the rows running parallel north and south. The mounded beds were 40cm high and on each mound ran 16mm Techline. Plants were placed at 50cm spacings, with a total of 600 *Solanum centrale* being planted.

No surface mulch or weed mat was utilised in this planting. Plants, seven months after planting, range in height from 25 - 60cm with a spread of 30 – 60cm. The plants in early Autumn are flowering, with young and mature fruits. Harvesting in small numbers commenced in March 2003.

Interestingly from the initial plantings side suckers have commenced growing with an average of 5-8 suckers or new plants emerging on the sides of the mounds. In some cases up to 12-13 new plants can be found coming from one original plant. It is possible on early indications that by early summer 2003 upwards of 6,000 plants may occupy this plot. No surface treatments will be undertaken with a view to monitoring the growth and yields of this plot.



New Spring plantings of *Solanum centrale* will be undertaken, with both first generation and second generation plants sourced from Pantharrpilenhe. Different surface treatments will be initiated with a comparative analysis being conducted against the original planting.

Should sucker growth be promoted on solanums or does the sucker growth impact on yields from the principal plant? What are the true advantages and disadvantages of using weed mat when cultivating native food plants, what role can organic mulches play or alternatively should no surface treatments be undertaken? These questions all need exploring.

Increased planting density with double rows per mound and at 25-35 cm spacings would allow for 1,800 – 2,400 plants on the current site where 600 plants were introduced initially. What are the implications of planting at such densities? Further research can't be undertaken until alternative planting densities have been undertaken and monitored over at least two years.

Fruit harvested from the “solanum patch” have averaged between 0.5cm – 1.7cm in size with an average 106 fruit per fruiting plant counted at the one time. Repeat flowering over a six month period will result in much greater yields per plant. Projected yields over the growing and fruiting season are currently unknown. More research is required before projected yields can be accurately forecast.

Table Twelve: Weight of *Solanum centrale* Fruit Freshly Harvested

Species <i>Solanum centrale</i> Size of Fruit	Number of Fruit	Weight of Fruit	Weight per Fruit
Large fruit (1.5 – 1.9cm)	500	950 grams	1.9 grams
Medium fruit (1.0 – 1.5)	500	650 grams	1.3 grams
Small fruit (0.5 – 1.0cm)	500	405 grams	0.82 grams

From the first harvesting fruit were graded and subsequently weighed, the results being as tabled above.

The first and second pickings of fruit harvested from the *Solanum centrale* plot were dried and subsequently weighed. The results are detailed below.

Table Thirteen: Average Weight for Dried *Solanum centrale*

Species: <i>Solanum centrale</i> Size of Fruit	Number of Fruit	Weight of Fruit (gm)	Average per Fruit (gm)
Large Fruit (1.5–1.9 cm)	100	125	1.25
Medium Fruit (1.0–1.5 cm)	100	88	0.88
Small Fruit (0.5–1.0 cm)	100	38	0.38
Mixed Sizes (0.5–1.7 cm)*	921 fruit	500	0.543
Mixed Sizes (0.5–1.7 cm)**	835 fruit	500	0.6

* Dried fruit from the first harvest undertaken at Pantharrpilenhe

** Dried fruit from the second harvest undertaken at Pantharrpilenhe

Table Fourteen: Percentage Weight Loss Between Fresh and Dried *Solanum centrale*

Species: <i>Solanum centrale</i> Size of Fruit	Average Weight of Freshly Harvested Fruits (grams)	Weight of Dried Fruits (grams)	Actual Weight Loss (grams)	Weight Loss % per Fruit
Large Fruit (1.5–1.9cm)	1.9	1.25	0.65	26.3%
Medium Fruit (1.0–1.5cm)	1.3	0.88	0.42	32.3%
Small Fruit (0.5–1.0 cm)	0.82	0.53	0.29	35.36%

Larger yields need to be graded and assessed both at the freshly harvested stage and after drying to accurately assess weight percentage loss.

A selective breeding program needs to be undertaken selecting species with a range of characteristics that will increase both quantity of fruit per plant, increased size and weight and importantly provide a consistent taste. *Sol. centrale* fruit range quite noticeably in flavour from being acrid to very sweet.

A significantly increased planting program of *Solanum centrale* is proposed for 2003-2004. With 500 metres of row space allocated on the current horticultural plot upwards of 4,000 new plants could be introduced. To accommodate 4,000 new plants double planting per row at 25cm spacing would be necessary. Trials will be undertaken that have different planting densities and different treatments.

On an assumed yield of 0.5 kilograms per plant (Graham & Hart 1997) in its second year it is anticipated that the new crop of solanum could realise 2 tonne of produce. At a farm gate price of \$20.00 per kilogram a gross return of \$40,000 is theoretically achievable.

With due respect to the statistics underlying the anticipated returns no evidence to date would suggest that this level of return is achievable on the current project site. With continued research, data to confirm or deny anticipated returns would not be available for at least two years.

With reference to the table below assumptions can be made as to likely yields per hectare. It should be noted that with reference to the largest fresh fruits (190 grams per 100 fruit) yielded to date on the Pantharrpilenhe solanum plot, each plant would need to produce slightly over 100 fruit 2.5 times per year to achieve 500 grams per plant.

Yield figures in the following table are based on the first harvest figures of 63.6 grams per plant, the gross yield per plant of 120 grams for 2003, and, an anticipated 0.25kg per plant in second year at first harvest and a possible total of 0.5kg per plant for the season of 2004.

Table Fifteen: Anticipated Yields per Hectare of *Solanum centrale*

Rows per Hectare (90m rows)	Spacing Between Rows	Planting Density per Row Metre	Plant Density per Hectare	Yield per Ha at 63.6 grams per Plant	Farm Gate Price \$15 per Kg
55	1.6m	2	9,900	0.63 tonne	\$9,444.60
55	1.6m	4	19,800	1.259 tonne	\$18,889.20
55	1.6m	6	29,700	1.889 tonne	\$28,333.80
					Farm Gate Price \$20 per Kg
55	1.6m	2	9,900	0.63 tonne	\$12,600
55	1.6m	4	19,800	1.259 tonne	\$25,180
55	1.6m	6	29,700	1.889 tonne	\$37,780
Rows per Hectare (90m rows)	Spacing Between Rows	Planting Density per Row Metre	Plant Density per Hectare	Yield per Ha at 120 grams per Plant	Farm Gate Price \$15 per Kg
55	1.6m	2	9,900	1.188 tonne	\$17,820
55	1.6m	4	19,800	2.376 tonne	\$35,640
55	1.6m	6	29,700	3.564 tonne	\$53,460
					Farm Gate Price \$20 per Kg
55	1.6m	2	9,900	1.188 tonne	\$23,760
55	1.6m	4	19,800	2.376 tonne	\$47,520
55	1.6m	6	29,700	3.564 tonne	\$71,280
Rows per Hectare (90m rows)	Spacing Between Rows	Planting Density per Row Metre	Plant Density per Hectare	Yield per Ha at 0.25 kg per Plant	Farm Gate Price \$15 per Kg
55	1.6m	2	9,900	2.475 tonne	\$37,125
55	1.6m	4	19,800	4.95 tonne	\$74,250
55	1.6m	6	29,700	7.425 tonne	\$111,375
					Farm Gate Price \$20 per Kg
55	1.6m	2	9,900	2.475 tonne	\$49,500
55	1.6m	4	19,800	4.95 tonne	\$99,000
55	1.6m	6	29,700	7.425 tonne	\$148,500
Rows per One Hectare (90m rows)	Spacing Between Rows	Planting Density per Row Metre	Plant Density per Hectare	Yield per Ha at 0.5 kg per Plant	Farm Gate Price \$15 per Kg
55	1.6m	2	9,900	4.950 tonne	\$74,250
55	1.6m	4	19,800	9.900 tonne	\$148,500
55	1.6m	6	29,700	14.850 tonne	\$222,750
					Farm Gate Price \$20 per Kg
55	1.6m	2	9,900	4.950 tonne	\$99,000
55	1.6m	4	19,800	9.900 tonne	\$198,000
55	1.6m	6	29,700	14.850 tonne	\$297,000

* A five metre diameter cleared area around the hectare plot has been allowed for fire breaks, wind breaks or machinery access, etc.

Planted Contoured Curved Water Harvesting Raised Beds:

A number of contoured raised beds were planted out with several species in September to November 2002. Species planted included *Santalum accuminatum*, *Santalum spicatum*, *Marsdenia australis*, *Ipomoea costata* and *Ipomoea polpha*.

The contoured beds, designed to capture surface run-off from rain water, have worked efficiently when it has rained with large pools of water congregating within the contoured curve. Impact on growth has been difficult to gauge as rainfall has been erratic with limited falls throughout the past nine months.

The *Ipomoea* species have thrived, while the plantings of *Santalum* with host plants *Myoporum parvifolium* have been less successful with only a 50% survival rate. Direct seeding trials with seed that has been previously stimulated into germination are anticipated.

Proposed Planting on Contoured Beds:

Sixty-two raised contoured beds ranging from four metres to twenty-four metres in length have been prepared for future planting. All beds have been designed to maximise capturing 100% of all rainfall on the project site, water that otherwise would have been lost due to the project site's aspect.

In total the 62 rows equate to 685 metres of planting row in length. Spacings are consistently at approximately 1.6 metres.

It is proposed that approximately 500 metres of beds will be allocated to cultivating *Solanum centrale*, *Solanum chippendalei* and *Solanum cheistogamum*. *Solanum chippendalei* and *Solanum cheistogamum* are considered to both have considerable commercial potential with particular reference to product flavour. *Solanum chippendalei* also has the added bonus of being a large fruit.

For the remaining 185 metres a majority of space will be allocated to plantings of *Marsdenia australis* and *Cucumis melo ssp agrestis*. Some allocation may be made for other species including *Cyperus bulbosus* and *Capparis spinosa ssp. nummularia*.

Cucumis melo ssp agrestis in the Tangentyere Bush Tucker Project on the Town Camps around Alice Springs have returned high yields when grown on raised garden beds. On the Pantharrpilenhe horticultural block limited trials were undertaken with *Cucumis melo ssp agrestis* with varying results. Limited plantings on natural stands have produced extremely poor returns, while plants given increased water and some greater protective shade have produced significantly higher yields. In favourable conditions yields of 180-200 fruit per plant were recorded.

Table Sixteen: Fruiting Details of *Cucumis melo ssp. agrestis*

Species: <i>Cucumis melo ssp. agrestis</i> Size of Fruit *	Percentage of Fruit Size to Plant Yield %	Average Weight per Fruit (grams)
Large Fruit	31%	4.76
Medium Fruit	24%	3.613
Small Fruit	45%	2.344

* Fruits were harvested prior to being fully ripe enabling yields to be recorded for the purposes of this report. Weight per fruit may have been slightly higher when fully mature. The average weight per fruit was 3.6 grams.

The *Cucumis melo ssp. agrestis* cultivated in this trial received very little treatment overall aside from some light side dressings of animal manures and some mulching with the manures and leaf litter. The proposed spring planting of *Cucumis meo ssp. agrestis* will see a series of controlled fertilising

programs for plants on raised beds growing as a ground cover and as a vine trellised up climbing frames that will provide some protection.

Establishing Wind Breaks:

Acacia victoriae have currently been used exclusively as a perimeter planting on the eastern and Southern boundaries of the horticultural plot. The *Acacia victoriae* are 6 - 12 month old seedlings.

Acacia colei and *Acacia coriacea* are being grown on with the intent of being inter-planted as foreground plants to the *Acacia victoriae* and for planting where able on the Northern and Western boundaries.

The three acacia species, considered to all have potential in the wattle seed industry, are being planted on irrigation with a view to establishing yields over the forth coming years. *Acacia murrayana* is another species worthy of consideration and will be included in the trial as plant material becomes available.

Planting with Natural Stands:

Limited plantings of *Cucumis melo ssp. agrestis*, *Ipomoea costata*, *Ipomoea polpha*, *Marsdenia australis* and *Rhyncharrhena lineris* were planted with a stand of *Acacia estrophiolata* and *Acacia victoriae*.

All plant species were irrigated by drip irrigation. Little or no other treatment was provided.

Growth rates, plant health and yields have all been poor with all species when grown with the natural stands. Comparisons with the fruiting yields of the *Cucumis melo ssp. agrestis* reveal that when cultivated alone and with increased management including some shade protection and increased irrigation yields increase upwards of ten-fold. Plant vigour was equally much greater.

Management of native food species grown in natural stands needs to be reviewed with greater intervention obviously required. The *Cucumis melo ssp. agrestis* or Native cucumber/ gooseberry has considerable potential as fresh produce for restaurants and possibly for the pickling industry with other native foods.

Providing Shade and Protection:

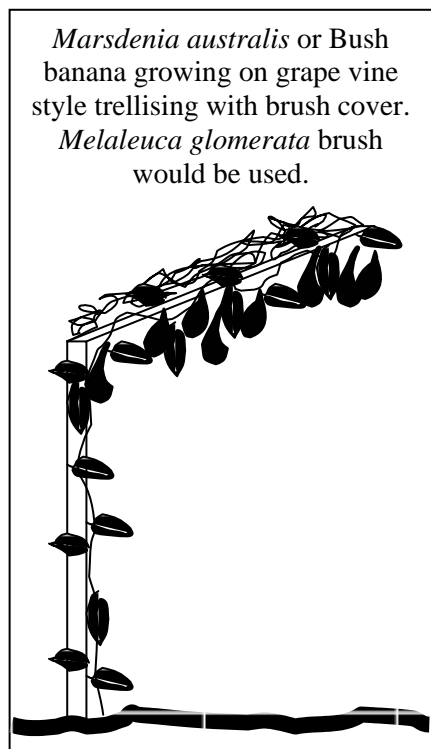
With a need to produce trellising for both the *Marsdenia australis* and *Cucumis melo ssp. agrestis* it is suggested that trials be undertaken where some shade is provided.

Shade could include shade cloth and/or brush cut from *Melaleuca glomerata*. *Marsdenia australis* are often found growing naturally on *Melealeuca glomerata*.

Trellising may be similar to a trellising style used in table grape vineyards. The vines would be trained to cover the trellising to ensure maximum coverage. *Marsdenia* tend to bolt quickly to anything they are grown on.

The style of trellising (to the right) and a simplified vertical trellising could be utilised.

Trellising would allow for closer density planting, provide some shelter and shade as commonly found in the habitats that *Marsdenia* are naturally found in. The sloping arm should allow for easier harvesting.



Mulching:

Little consideration was given to introducing any mulching program into the first trials. The use of weed mat as a surface treatment and the use of easily available and economically viable bales of lucerne may be two options for experimenting with mulching as a weed suppressant, soil temperature moderator, soil conditioner and water saver through reducing loss of moisture due to evaporation.

Soil Conditioning & Fertilising:

The initial focus with this nine month native food trial has been on establishing the infrastructure, and planting a range of native food plant species.

Initial soil treatment using gypsum at the rate of 0.5kg per metre was undertaken with a similar application applied after six months.

A pre-planting NPK fertiliser and a high nitrogen fertiliser were applied when the cultivation rows were being formed. With the planting now established in the first phase consideration to conducting fertilising trials is now able to be contemplated.

4.2.2 Cultivating Native Food Plants on Existing Natural Stands

As detailed elsewhere in the report the trial of growing native food plants within existing stands of vegetation has proved largely unsuccessful.

With the exception of the *Ipomoea costata* all other species struggled. Plant growth and health were generally poor and yields were extremely low when compared with similar species given different circumstances.

Competition from surrounding vegetation was the most likely cause for the poor growth and yields although growth inhibitors from the naturally occurring species may be a contributing factor. Greater intervention with respect to watering and fertilising would need to be undertaken to test this theory.

4.2.3 A Focus on Drip Irrigation

Low pressure water efficient irrigations systems are an absolute necessity in remote communities where conservation of available water must be given priority. Overhead watering, spray systems and flood irrigation are certainly deemed wasteful and not suited to the arid situation.

The issue of applying any water other than by drip irrigation is best illustrated by the fact that the mean average annual evaporation rate is 3,066mm.

The two irrigation types trialed in this project, one using four litre per hour pressure compensating drippers, and the other using 16mm Techline that has internal line emitters, both have proved efficient and reliable.

Issues of management of the systems need to be given priority with filtration systems regularly needing to be checked and irrigation lines needing to be regularly flushed and cleaned to prevent possible blockage of the emitters.

Thorough training in the maintenance needs of irrigation systems needs to be given priority in any horticultural training programs.

The irrigation regimes programmed were regularly adjusted to suit the climatic conditions and to reflect plant needs as flowering and fruiting occurred.

More experimentation is required with select species. By managing water quantity applications it is possible that several species may be induced to flower and fruit several times over a twelve month

period. Reference should be made to the section on “Native Food Plant Species Utilised in the Project” for further information.

Issues of plant watering needs, the ability of a plant to flower and fruit several times a year and soil management issues of alkalinity and salinity all directly relate to water application.

A recent soil analysis of the Solanum plot revealed that the pH at surface level had a reading of 7pH and at 20cm depth a reading of 8pH. The original tests on this site revealed the site was moderately alkaline with a reading of 7.9pH. The water being applied to the site has a pH reading of 7.6pH.

The issue of alkalinity at this stage appears not to be an issue, although having stated this most horticultural projects from the home garden to large vineyards all need to be aware of the potential problems that may be encountered with alkalinity when undertaking any horticultural enterprise in the arid zones of Australia.

With respect to the Electrical Conductivity the original soil analysis revealed an optimal level reading of 0.10dS/m. Recent tests reveal that at surface level a high reading of 6.35 dS/m was registered while at a depth of 20cm the reading was 0.35 dS/m.

The EC readings suggest that salt levels are building up to high levels on the surface while below there has been only a slight increase.

Issues of management of watering need to be given the highest priority as in this instance the Total Dissolve Salts in the water being applied registers as being 1590ppm.

Once crops are established it is essential that long deep waterings are programmed to limit potential salt build up on the soil surface. Daily or regular light applications of water are likely to contribute to high water loss through evaporation and subsequent build up of surface salts.

Deep long watering at extended intervals are most appropriate for this situation.

The issue of water availability when watering programs are managed by a controlled or programmed operation become an issue. If tanks aren't filled an automatic watering system may indicate that water has been applied when in fact a lack of water in the feeder tanks may mean little or no water has in fact been applied.

The need for bore pumps to be programmed to correspond with any watering regimes and the need for water meters to be installed to enable accurate recording of water quantities being applied needs to be addressed in any future programs.

A controlled irrigation regime that is based on night time watering and long deep waterings to promote deep rooting as against daily or regular light watering regimes is recommended. Light surface watering with high evaporation rates will naturally lead to surface salinity issues with respect to the water quality often found on locations in Central Australia.

Water management, the continued application of gypsum as a soil/salinity management tool and the possible need to apply surface mulches to reduce water loss through evaporation all need to be given priority consideration when establishing a horticultural enterprise under circumstances similar to those experienced at Pantharrpilenhe.

4.2.4 Introducing Water Harvesting into the Project

With the potential for problems of alkalinity and salinity arising the highest priority needs to be given to instigating water harvesting initiatives as a basic management tool.

With the Pantharrpilenhe site being located on a hill slope the potential for introducing water harvesting opportunities was considerable. The highest priority was given to contouring the surface to

ensure that all surface rainwater was able to be captured and utilised. Reference should be made to Map Four: “Layout of Beds with a Strong Focus on Water Harvesting.” Limited rainfall over the past nine months has meant that any possible positive impact the water harvesting initiatives may have had has been limited.

For the long term sustainability of the project it was considered essential that water harvesting techniques had to be incorporated into the design elements of this project.

The concept of water harvesting is little understood or more pointedly little appreciated as a valuable management and water conservation technique that has applications in many situations within the Australian home gardening and horticultural context. A reference to most gardening or horticultural literature will reveal little on this issue.

Much greater research is required in this area with the need to promote a range of initiatives applicable to various enterprises and for this information to be documented and published with a view to promoting the benefits of introducing water harvesting as a cost effective and environmentally sound management tool.

5. Recommendations

Taking into account the original objectives of the project, the revised contract agreement between Centralian College and CLC signed 1st July 2002 and the contents of this report a number of recommendations are forwarded for consideration. All recommendations listed below can be found within the contents of the report.

In summary there are two principal recommendations. Underlying these two recommendations are a series of subsidiary recommendations that arise out of discussion within the contents of the report.

In summary it is recommended:-

- (1) That funding be allocated for at least a 2-3 year period to allow for the continuation of the RIRDC Pantharrilenhe research and development project originally titled “Cultivation and Sustainable Wild Harvest of Bushfoods by Aboriginal Communities.”
- (2) That the concept to develop a complete model supporting the establishment and maintenance of native food enterprises on Aboriginal communities be supported.

Arising from this report a series of complimentary recommendations need to be given consideration. These recommendations in detail are as follows.

- That with sustained research the opportunity exists for the development of an “Australian Native Foods Information Kit” with a particular focus on plants endemic to Central Australia.
- There exists a definite need for more data collection and research to be undertaken to provide complete plant profiles to assist with the future development of the Australian native food industry, certainly from a production horticulture perspective.
- The need to develop improved cultivars and explore a range of marketing opportunities exists with both recognised native food species and the currently little known species.
- That funding for the development and publication of information on selected species with a view to producing fact sheets on native food species for distribution needs supporting.
- That the partnership agreement, between RIRDC the principal funding body, CLC the Project Managers, Centralian College as Research Managers and the Pantharrilenhe community as the project participants, be supported.
- That for the long term sustainability of the enterprise, the development of a sound knowledge and skills base has to be considered essential. Provision needs to be made for an extension of training for the Pantharrilenhe project participants.
- The necessary infrastructure has been installed and equipment is available to allow for fertigation trials to be undertaken with a view to establishing the nutrient requirements of various bush foods. This area needs further research.
- To further the concept of developing the native foods industry thought should be given to the development of a training program within the national horticultural package that has a bush foods focus.

- That a “self help” pamphlet and accompanying poster be developed for distribution to Aboriginal communities throughout Central Australia. This “self help” pamphlet would detail resources available to assist people on communities in establishing native food enterprises.
- That a coordinated support services structure needs to be created whereby agencies are working together co-operatively to minimise duplication and ensure resource allocation is efficient and productive.
- Support services need to be able to provide not only immediate assistance with reference to the planning and establishment of projects but also need to be resources themselves to provide longer term services over extended periods.
- The concept of a support agency providing a Field Officer who is able to regularly visit horticultural enterprises throughout Central Australia and provide technical advice, short bursts of training and bring products, materials and equipment as required is a concept that needs exploring further.
- If this (Pantharrpilenhe) native foods project is to continue and expand in the future the second suitable site identified will need to be developed with infrastructure needing to be established.
- The development of a site selection criteria formulae needs to be documented in a user friendly form and promoted as a key planning component when communities are considering developing a production horticulture enterprise.
- In the long term investment should be made in a solar system capable of meeting the water quantity needs of the Pantharrpilenhe community and the horticultural enterprise.
- In recognising the climatic extremes, the limited and often unreliable rainfall, the soil types where high pH is common and organic content is often limited, techniques appropriate for an arid zone need to be incorporated in horticultural enterprises on Aboriginal communities.
- To improve quality and reliability of yield and produce, knowledge and techniques must be acquired and developed to allow for high propagation success rates when using vegetative material. Further research is definitely required in this area.
- To date no comparative analysis has been completed using “the Fire Method” as against using smoked water. This comparative analysis needs to be undertaken.
- Projected yields (from the Pantharrpilenhe project) over the growing and fruiting season are currently unknown. More research is required before projected yields can be accurately forecast.
- A selective breeding program needs to be undertaken selecting species with a range of characteristics that will increase both quantity of fruit per plant, increased size and weight and importantly provide a consistent taste.
- While trials to date have not been undertaken antidotal evidence would suggest that *Capparis mitchelli*, *Capparis spinosa ssp. nummularia* and *Carissa lanceolata* may respond well to direct seeding in spring. Further research on direct seeding needs to be undertaken.
- Management of native food species grown in natural stands needs to be reviewed with greater intervention required.
- That continued research needs to be undertaken to develop appropriate management treatments and tools for the cultivation of Australian native foods.

- Much greater research is required in this area (water harvesting) with the need to promote a range of initiatives applicable to various enterprises and for this information to be documented and published with a view to promoting the benefits of introducing water harvesting as a cost effective and environmentally sound management tool.

6. Bibliography

- Australian Plant Society, Alice Springs, 2nd ed. 2000 "*Local Plants for Central Australian Gardens*", Alice Springs
- Brand, J & P. Maggiore, 1992. "*The nutritional composition of Australian Acacia seeds.*" In: A.P.N. House and C.E. Harwood (eds), *Australian Dry-zone Acacias for Human Food Proceedings of a workshop held at Glen Helen, Northern Territory, 7-10 Aug. 1991*, CSIRO Division of Forestry & Australian Tree Seed Centre, Canberra.
- Chippendale, T.M. 1975, *Wildflowers of Central Australia* Ure Smith, Sydney
- Chisholm, J. 2002, *History of Bushfoods at Napperby Station* Desert Knowledge Publication, Alice Springs
- Goddard, C. & Kalotas, A. (eds) 1988, *Punu: Yankunytjatjara Plant Use*, IAD Press, Alice Springs
- Graham, C & D. Hart (1997) "*Prospects for the Australian Native Bushfood Industry*," RIRDC Research paper No 97/22, Barton ACT
- Grant, W.J.R. & Buttrose, M.S. 1978, "*Domestication of the Quandong Santalum acuminatum (R.Br) a. DC.*", *Australian Plants*, Vol 9, no. 75
- Horner, R. 2002, *Wild Harvest* Desert Knowledge Publication, Alice Springs
- Latz, P. 2002, *Native Plants with Market Potential* Desert Knowledge Publication, Alice Springs
- Latz, P. 1995, *Bushfires & Bushtucker Aboriginal Plant Use in Central Australia* IAD Press Alice Springs
- Lister, P.R., P. Holford, T. Haigh, and D.A. Morrison, 1996 *Acacia in Australia: Ethnobotany and potential food crop*. P. 228-236. In: J. Janick (ed), *Progress in new crops*. ASHS Press, Alexandria, VA.
- Morse, J. 1999, *Aboriginal Involvement in Bushfood and Other Enterprises in Central Australia*. Central Land Council, Alice Springs
- Pechey, B. 2002, *Aboriginal Participation in the Bush Foods Industry* Desert Knowledge Publication, Alice Springs
- Quarmby, M. 2002, *Bushfoods: Commercial Background in South Australia* Presentation Desert Knowledge Bushfoods Workshop, Alice Springs
- Richardson, M. 2002, *Bushfoods: Selection and Propagation* Desert Knowledge Publication, Alice Springs
- Robins, J. 2002, *Bush Food Workshop Paper National & International Market Background* Desert Knowledge Publication, Alice Springs
- Sawenko, T. 2002, *The Coles Indigenous Food Fund* Desert Knowledge Publication, Alice Springs