The Commercial Potential of Red Bayberry in Australia

by Daryl Joyce and Garth Sanewski

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Researcher Contact Details

Daryl Joyce
School of Land, Crop and Food Sciences
The University of Queensland
Gatton, QLD 4343

Phone: 61 (0)7 54601725
Fax: 61 (0)7 54601112
Email: d.joyce@uq.edu.au

In submitting this report, the researcher has agreed to RIRDC publishing this material in its edited form.

RIRDC Contact Details

Rural Industries Research and Development Corporation
Level 2, 15 National Circuit
BARTON ACT 2600

PO Box 4776
KINGSTON ACT 2604

Alan Davey
Senior Research Manager, New Plant Industries

Phone: 02 6271 4100
Fax: 02 6271 4199
Email: rirdc@rirdc.gov.au.
Web: http://www.rirdc.gov.au

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Foreword

The introduction of new industries and products plays an important role in the growth and development of Australian agriculture.

Originally from China, Red Bayberry (*Myrica rubra*) represents a potential opportunity for increased fruit production and sales for domestic and, potentially, international markets.

Red Bayberry fruit are attractive and tasty. They are typically deep red in colour when ripe, about the size of lychee fruit, with a soft chewy texture and a central hard cherry-like stone.

Taste tests show that their sugar:acid balance and flavour are widely agreeable to the consumer palate.

A previous study (RIRDC Publication No. 05/081) entitled ‘Red Bayberry – A New and Exciting Crop for Australia?’ presented general information on this unusual fruit crop.

The present project sought to determine the commercial potential of fresh Red Bayberry fruit in Australia, particularly in terms of consumer acceptance and yields from superior genotypes.

The research clearly established that Australian consumers like, and would include the purchase of fresh Red Bayberry fruit, in their discretionary berry fruit expenditure.

The work also showed that Red Bayberry plants, including of the selected superior female (fruiting) genotypes N1MR6 and 9, grow and produce well in sub-tropical Australia.

The report also explores supply chains - covering nursery, grower and retailer interests.

A follow-on project proposal exploring the pilot production and sales of red bayberry in Australia has recently commenced.

In the medium to long term, nurseries, growers, wholesalers, retailers and consumers stand to benefit from this innovative R&D.

This present project was funded from RIRDC core funds which are provided by the Australian Government.

This report, an addition to RIRDC’s diverse range of over 2000 research publications, forms part of our New Plant Products R&D program, which aims to facilitate the development of new industries based on plants or plant products that have commercial potential for Australia.

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Craig Burns
Managing Director
Rural Industries Research and Development Corporation
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Contents

Foreword ................................................................................................................................................ ii

Acknowledgments................................................................................................................................ iv

Executive Summary ............................................................................................................................ vii

Introduction ........................................................................................................................................... 1

Objectives ............................................................................................................................................... 3

Methodology .......................................................................................................................................... 4

Results .................................................................................................................................................... 7

Implications.......................................................................................................................................... 13

Recommendations ............................................................................................................................... 14

Appendices ........................................................................................................................................... 15

References ............................................................................................................................................ 36
Figures

Figure 1. Maroochy Research Station (MRS) site (Google Earth image, 2007; downloaded 2010)....................6

Figure 2. Project staff member Khamla Mott (LHS) conducting consumer survey at Fine Fruit on James in Fortitude Valley, Brisbane (image by M. Cover). .................................................................7

Figure 3. N1MR9 Red Bayberry fruit harvested at Maroochy Research Station in 2010 (image by K. Mott) ...8

Figure 4. Four Red Bayberry plants photographed in 2010 at ~7 years old from seed at DPI Victoria research station at Tatura, Victoria.................................................................9

Figure 5. Seven Red Bayberry plants photographed in 2010 at ~3 years in-ground from cuttings at Henry Kita’s property near Silvan, Victoria.................................................................10

Figure 6. Four Red Bayberry plants photographed in 2010 at ~3 years in-ground from cuttings at John Stewart’s property near Silvan, Victoria.................................................................10

Figure 7. Two of 12 N1 series (older; cf. Figure 7) Red Bayberry plants photographed in 2008 at ~3 years old in-ground from cuttings at Maroochy Research Station at Nambour, Queensland...........11

Figure 8. Part of two rows comprising 141 N2 series (‘younger’; cf. Figure 6) Red Bayberry plants photographed in 2008 at ~2 years old in-ground from seed at Maroochy Research Station at Nambour, Queensland (image by Q. Son Dinh). .................................................................11

Appendices

Appendix 1. Abstracts from and references for consumer surveys on imported (3.1) and local (3.2 and 3.3) Red Bayberry fruit of Biqi heritage. .................................................................15

Appendix 2. Progressive update summaries for RIRDC Project PRJ-002435 ‘Commercial Potential of Red Bayberry in Australia’ (RIRDC Project No PRJ-000527). ...........................................19

Appendix 3. Notes on aspects of agronomy for Red Bayberry (by Dr Garth Sanewski). .............................25

Appendix 4. Summary general guidelines for Red Bayberry cultivation (by Dr Garth Sanewski). ..............32

Appendix 5. Poster on Red Bayberry presented at an Australian Society for Horticultural Science conference. .................................................................35
Executive Summary

What the report is about

This report is about establishing the commercial production and sales potential of Red Bayberry in Australia. Red bayberry (*Myrica rubra*) is a summer season fruit crop from Zhejiang and other provinces of China. It offers an exciting novel opportunity for Australia. Export market opportunities are possible in the longer term, including counter-season marketing into China.

Who the report is targeted at

This report is targeted at potential Red Bayberry growers and marketers in Australia. It follows on from an initial scoping project entitled ‘Red Bayberry – A New and Exciting Crop for Australia’ (RIRDC Publication No 05/081). As such, it represents part of ongoing work intended to provide pre- and postproduction horticulture industry members will sufficient background information and data for confident investment in this new crop.

Background

In the Zhejiang Province of China, Red Bayberry is second only to citrus in terms of importance as a fruit crop. Red Bayberry’s geographic range is associated with mandarin, loquat, green tea and bamboo. Accordingly, it grows in mild temperate to tropical environments. The berry-like fruit are attractive and tasty. They are typically deep red in colour when ripe, about the size of a small lychee fruit and have a soft texture with a central cherry-stone-like seed. Their sugar:acid balance and flavour are generally agreeable to the European palate. Red Bayberry fruit can be canned, frozen, juiced and made into soft beverages as well as wine and spirits.

Aims/objectives

The overall aim of this project was to ascertain the commercial potential of Red Bayberry in Australia. General project objectives were to evaluate Australian consumer acceptance, create a business plan for commercialisation, procure elite germplasm and establish trial plantings. In the course of the project, specific objectives were modified in order that difficulty in procuring elite germplasm from overseas did not become an impediment to meeting general objectives and realising the aim.

Methods used

Four integrated approaches were used to meet the project aim. Three successive consumer surveys were conducted; these being with untrained tasters (n = 17) on Biqi fruit from China, with trained focus group tasters (n = 61) on Red Bayberry fruit (including lines N1MR6, 7 and 9) from Maroochy Research Station (MRS), Queensland and with untrained tasters (n = 126) on N1MR9 fruit from MRS. Business plan development was commenced with a combined production push – market pull business strategy through interaction with pre- and postproduction members of both horticulture and food industries in Queensland. Subsequently, a value chain based business plan was developed with assistance from UniQuest. Investigations into and attempts to import Red Bayberry cultivars from China, Japan and Florida were made. Thereafter, because of importation difficulties, superior clones were selected at MRS from within existing seed-derived germplasm in Australia. Finally, germplasm was grown-out in Queensland at UQ Gatton and MRS, Nambour and in Victoria at DPI research station Tatura and two farms near Silvan. Agronomic information was collated for the oldest (N1 series) plants at Nambour.
Results/key findings

In terms of key results, Australian consumers in three separate surveys were positive about the prospect of fresh Red Bayberry fruit being offered for sale in Australia. For the most part, they considered that the fresh fruit should be marketed as ‘berry fruit’ and packaged and priced accordingly. Expressions of interest from potential Australian growers in response to press releases implied good prospects for production push. However, from the market pull perspective, fresh fruit marketing and food processing companies in Queensland were reserved in their responses. It was determined that a value chain alliance comprising research, nursery, grower and retailer expertise and facilitated with commercialisation acumen is the most appropriate approach to future pilot scale production and marketing in Australia. Established Red Bayberry cultivars were not imported into Australia because of reluctance to part with elite germplasm and problematic logistical issues. However, two superior cv. Biqi-like female lines (N1MR6 and 9) were identified among seed-derived genotypes as substitutes. From field trialling in Queensland and Victoria, it was confirmed that the sub-tropical Nambour region of Queensland was well suited for Red Bayberry production. At Maroochy Research Station, trees grew rapidly and yield well with little fertiliser and irrigation input and few pest and disease problems.

Implications for relevant stakeholders for:

The general implication from this research into ‘potential in Australia’ is that pilot scale production of fresh fruit Red Bayberry selections N1MR6 and 9 fruit should be initiated as soon as practical on fruit farms in sub-tropical regions of Queensland and New South Wales. The present project has established very clearly that Red Bayberry fruit can be produced relatively easily in Australia and that Australian consumers would purchase the fruit as part of their discretionary berry fruit spend. Key stakeholders in pilot scale operations should include nursery, grower and retail operators in collaboration with research and commercialisation agencies.

Recommendations

It is recommended that, in association with RIRDC, the following activities be undertaken to facilitate pilot scale production of Red Bayberry in Australia: i) selection of additional superior Australian red bayberry clones for fruit quality characteristics; ii) IP protection of selected clones; iii) commercial scale propagation of selected clones for trialling in Queensland and Northern New South Wales; iv) pilot commercial scale trial plantings on grower’s properties for fruit production; v) refinement of agronomic practices (e.g. pruning and thinning); vi) protocols for post-production fruit packaging, handling and marketing; and vii) pilot scale test marketing of fruit from selected clones.
Introduction

Red Bayberry, Chinese Bayberry or Yang Mei (*Myrica rubra*) is a summer season fruit crop grown in Zhejiang and other provinces of China. The attractive tree is also used as an ornamental in Japan.

In Zhejiang Province of China, Red Bayberry is second only to citrus in terms of importance as a fruit crop. Red Bayberry’s geographic range is associated with mandarin, loquat, green tea and bamboo. Accordingly, it grows in mild temperate to tropical environments.

The attractive and tasty fruit are deep red in colour when ripe, about the size of a lychee. They have a soft texture with a central seed about the size of a cherry stone. The sugar:acid balance and flavour are agreeable to the European palate. Dr Alan Legge (pers. comm.), retired former Technical Director of MW Mack Multiples, the largest UK-owned fruit and vegetable supplier to the British supermarket chains, suggests that Red Bayberry has enormous market potential.

In the past, principal investigator D. Joyce worked in collaboration with Chinese colleagues at Hangzhou University of Commerce on the postharvest handing of Red Bayberry. This initial work was funded by a British Council Higher Education Grant and extended over a 3-year period when Prof. Joyce was working in the UK. Considerable experience was thereby obtained on the postharvest of Red Bayberry, and collaborative links with China were secured.

Red Bayberry offers a potentially novel and exciting opportunity for Australia. New fruit crops have great marketability, as has been shown in recent times by the New Zealanders with Zespri™ Gold. Moreover, Red Bayberry fruit should have initial potential for fresh fruit sales to people of Chinese origin through domestic markets. In the longer term, a surge in demand from a broader cross-section of Australian consumers as well as export markets, is anticipated. A future option may include counter-season marketing into China, perhaps as a joint venture. In addition, the fruit can be canned, frozen, juiced and made into soft beverages as well as wine and spirits.

In the course of a preceding RIRDC project, a written review of the Chinese experience with Red Bayberry agronomy and postharvest was prepared. The abstract and reference are presented immediately below. Presentations to researchers and industry based on this review were presented at the Australasian Postharvest Horticulture Conference (2003) and the New Crops Conference (2004).

Abstract: “Red Bayberry plants are evergreen trees cultivated in hilly areas of south-eastern China. The plant bears edible fruit. There are also local uses for its seeds, leaves and roots. The Red Bayberry plant has a height of 2-10 m and a uniform round-shaped canopy. Red Bayberry trees grow well on poor soils due to a nitrogen-fixing bacterium association with the root system. Thus, strong growth and high productivity can be achieved on infertile hill slopes. Male and female catkins are on separate plants and pollination is by wind. Red Bayberry fruit from cultivation can be about 3-cm diameter. The edible portion is comprised of many soft and succulent segments in a radial arrangement, around a single cherry stone-like seed. The fruit surface is characterised by many small swellings, which are distal tips of the segments. Fruit vary in size, colour and ripening time depending upon the variety. Fruit of most cultivars are 10-20 g-weight and 2-3 cm-diameter and bright red to almost black in colour. The fruit ripen in China from mid-June to early July, in mid-Summer. The harvest period is short, being just 2-3 weeks duration. Red Bayberry fruit are harvested when appearance and taste are optimal. The fruit have a palatable sugar-acid balance. They contain a broad spectrum of vitamins (e.g. vitamin C, thiamine, riboflavin, and carotene) and minerals. Harvested Red Bayberry fruit rapidly break down under ambient conditions, and present similar post-harvest handling challenges to temperate berry fruits. Their delicate nature makes it difficult to store and transport the fresh fruit. Appropriate packaging, careful handling and maintenance of the cool chain are fundamental to efficient handling and distribution of Red Bayberry fruit. These difficulties present a challenge to long –distance transport, however this shortcoming is not insurmountable. Red Bayberry fruit are also processed into juice and wine and canned, frozen or dried as alternatives to fresh consumption. Red Bayberry fruit are in strong demand and production in China has increased dramatically over the last decade. In the context of introducing this crop into Australian horticulture, this report presents general information on the cultivation of Red Bayberry plants and features information on
post-harvest characteristics of the fruit. An investigation of climatic similarities between production areas in Zhejiang and potential areas in Australia reveals that Red Bayberry has specific requirements not only for a warm – temperate range of temperatures, but also requires high humidity as fruits swell and ripen. This latter requirement is likely to limit the potential range within Australia of this exciting new crop, however close climatic matches do exist between production areas in Zhejiang, and some northern and eastern coast horticultural regions. The authors are confident that the crop will succeed horticulturally in Australia. The next challenge is to establish plantings, and commercial structures to optimise market development.”.


This project report was accompanied by a project DAV-212A trip report also published by RIRDC. Again, the abstract and reference are presented immediately below.

Abstract: “The Red Bayberry is a unique Chinese fruit crop, mainly cultivated in the subtropical region of southeast China. It has berry-like fruit with a palatable sugar-acid balanced flesh. It is extremely popular in China. The rapid expansion of Red Bayberry industry in the last two decades in China suggests its potential for worldwide production. Opposite climatic conditions offer Australia an opportunity for counter-seasonal production. The recent study tour was to gain insight into Red Bayberry production, processing and marketing in China and to examine the possibility of developing an industry in Australia. This report summarises the history, distribution and climatic requirements of Red Bayberry production in China, and recent research and development of the industry, particularly for germplasm and cultivars, cultivation techniques, disease and pest management, and harvest and handling. The potential development of the Red Bayberry industry within Australia is discussed in relation to Australian climatic and environmental conditions.”.


Readers of the present report are referred to the two abovementioned RIRDC reports for detail on Red Bayberry overseas, particularly in China.
Objectives

The initial objectives of this project were to:

1. evaluate Australian consumer acceptance of Red Bayberry
2. create a business plan for commercialisation of Red Bayberry in Australia
3. import the most popular elite cultivar from China
4. establish trial plantings at locations from north Queensland to Victoria.

Because importation of elite cultivars proved problematic, objectives 3 and 4 in particular were modified to accommodate working with Red Bayberry lines from seed imported and germinated in earlier and parallel work by principal investigator D. Joyce.

Consequently, objectives 3 and 4 became to:

- determine elite lines within germplasm available in Australia
- grow Australian germplasm at trial sites in Queensland and Victoria.
Methodology

Intended approach

It was initially intended to establish a value chain relationship to propagate, grow and market Red Bayberry to ensure orderly introduction of the fruit onto the market to ensure that members of the chain, including growers, were positioned as price makers and not price takers. The project was to be managed by a reference group comprising a research and industry partner along with marketing agency members. These organisations were to form the core of a value chain for production and marketing of Red Bayberry fruit. In a temporal context, the plan was - Year 1: Evaluation of Australian consumer acceptance of Red Bayberry. Year 2: Importation of a popular elite cultivar from China; Year 3: Development of a business plan for commercialisation; and, across Years 2 to 5: Trial plantings at locations from north Qld. to Vic.

Adopted approach

The intended approach was generally followed. However, because import of fresh fruit and elite germplasm proved problematic, the planned approach required modification. The research partner (UQ) and a member nursery (Birdwood) of the industry partner group (ANFIC) worked towards propagating Red Bayberry germplasm already in Australia. DEEDI (Department of Employment, Economic Development and Innovation; formerly QDPIF) was sub-contracted for assistance with agronomic and trained consumer evaluation work. Trial plantings were established in Victoria as well as Queensland.

Trials and methods

[Note: detail pertaining to the methods is presented in Appendices 1 to 5]

Consumer acceptance – A series of three consumer acceptance studies was conducted over the project period (Appendix 1). These studies were with a small untrained taste panel comprised of volunteers from AQIS and BSES, a trained taste panel (focus group) recruited by IFT and shoppers at a green grocer (Fine Fruit on James), respectively.

For the first study (2006), with the co-operation of AQIS, fresh Red Bayberry cv. Biqi fruit were brought from China (Guandong via Hong Kong) to quarantine facilities at Brisbane airport. Within these facilities, tasting was carried out by an untrained panel.


For the second study (2008), IFT (DEEDI) was sub-contracted to conduct trained consumer taste panel assessment of fresh Red Bayberry fruit produced from Australian germplasm grown at DEEDIs Maroochy Research Station (MRS) near Nambour, Qld.


The third consumer study (2009), a second with untrained tasters, was conducted at a fruit store (Fine Fruit on James) in Fortitude Valley, Brisbane using fresh Red Bayberry fruit from MRS.

Business plan -

In the light of prohibitive difficulties encountered in importing elite Red Bayberry germplasm, business planning was delayed in the project and approached as a business strategy aiming to marry production push with market demand.

Production push was focused on selection of superior female fruiting lines within Red Bayberry germplasm in Australia growing at MRS. Selection was coupled with consumer testing. The medium term intent was to propagate-up one or more elite female (fruiting) lines, plus one or more male (pollinator) lines, for growers in Australia to trial in future pilot scale operations. A press release was issued by UniQuest to gauge potential grower interest. Also, two fresh produce marketing organisations based at the Brisbane markets, Carter & Spencer and Favco Qld Ltd, were approached by the project team with facilitation by UniQuest.

The potential of market demand was investigated by approaching potential users of processed Red Bayberry products (e.g. juice, pulp) that could be used in food manufacture (e.g. fruit juice mixes and fruit flavoured dairy products, like ice cream). Food companies engaged with in this context included Grove fruit juice, Food Spectrum and Lick ice cream. Food Spectrum imported fruit juice concentrate from a food company in Zhejiang Province (Haitong) for in-house investigations.

Both fresh fruit marketing organisations and food processing companies expressed reservations in dealing with a completely new product in Australia. On the other hand, potential growers expressed interest and Birdwood Nursery, an ANFIC (Australian Nurserymen's Fruit Improvement Company Limited) member nursery, was enthusiastic about propagating promising Red Bayberry lines. Consequently, a value chain partnership business model was proposed with a view to progressive introduction of fresh Red Bayberry fruit to Australian consumers while realising return on investment by growers into pilot scale production.

Elite cultivars – In addition to a visit to China (2007; Appendices 2 and 3) by D. Joyce, G. Sanewski and S. Wei seeking access to elite germplasm as well as information on Red Bayberry plant improvement and agronomy, earlier representations (2005 onwards) were made to an Australian nurseryman (Mr James McGeogh) with joint operations in China and to tree fruit breeders in Florida and Japan who had Red Bayberry cultivars in their germplasm base. However, while courteous and informative, the Chinese were not interested in providing germplasm to the project. Workers in both Florida (via Mr Gavin Porter, ANFIC) and Japan (via Mr Garth Sanewski, DEEDI) kindly despatched germplasm in two and one consignments of bud sticks, respectively. Unfortunately, budsticks of all lines (except one non-elite line from Florida) were either lost in transit or had deteriorated and could not be successfully grafted onto rootstocks derived from seeds and provided from UQ to the post-entry quarantine greenhouse facility (Mr Dave Spence) in Brisbane.

In view of recurrent setbacks with germplasm importation, the fall-back position was growing-on D. Joyce’s seed-derived Red Bayberry plants to flowering and fruiting as opposed to only using this germplasm to provide rootstocks. In this context, Gavin Porter (ANFIC) suggested that around one at least in 30 seedlings should have characteristics similar to the elite parent line, presumed to be Biqi.

Plantings –

Vegetatively propagated progeny of an initial 12 Red Bayberry seedling plants brought to Queensland by D. Joyce in 2003 were planted-out at MRS (Figure 1) in September 2005 (Appendix 3). These were coded MR1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 12 and 13. MR stands for *Myrica rubra*. The coding for this planting was later changed to N1MRx with N1 meaning Nambour planting no. 1. A further 141 seedlings (coded N2MR1 to 141) derived from a Red Bayberry seed lot brought to Queensland from Victoria and planted in 2003 were planted-out at MRS in September 2006.
Figure 1. Maroochy Research Station (MRS) site (Google Earth image, 2007; downloaded 2010).

The 12 older Red Bayberry trees can be seen (left to right) in the row of trees immediately below the red line on the LHS of the image. The 141 younger Red Bayberry trees were planted where indicated by the red line on the RHS of the image within the covered greenhouse structure.
Results

1. Australian consumer acceptance

In a series of three consumer studies, fresh Red Bayberry was very well received by Australians (Appendix 1). Fresh fruit of both cv. Biqi fruit imported from China and several lines grown at Nambour were well received on the basis of colour, flavour and mouthfeel.

In the first trial with imported fruit, consumers \( n = 17 \) scored them 7.2, 6.9, and 6.7 for appearance, flavour, and mouthfeel, respectively, on a linear 9-point hedonic rating scale from 1 = dislike extremely to 9 = like extremely (Joyce 2007). The fruit was judged to be attractive and juicy, with a good sugar/acid balance and a pleasant mouthfeel.

In subsequent work (Reid et al. 2009) with a consumer focus group \( n = 61 \) and using Australian germplasm, Red Bayberry lines N1MR7, N1MR9 and N1MR6 were afforded very good likability scores (1 to 100 scale) for overall (average across lines = 66), appearance (av. = 72), flavour (av. = 64), texture (av. = 65) and aftertaste (av. = 60). The focus group anticipated seeing Red Bayberries in the berry-fruit section of fruit and vegetable shops and paying about $4 to 6 for a strawberry-sized (250 g) punnet. Red bayberry lines from MRS were also subjected to compositional chemical and nutritional analyses (Appendix 1.2B).

In the third survey (Cover et al. 2010; Figures 2 and 3) with fruit of line N1MR9, 126 shoppers at a green grocer in an inner Brisbane city suburb recorded relatively high averaged scores on a 1 to 10 scale of 8.8, 7.1 and 7.1 for appearance, flavour and texture, respectively. The consumers \( n = 74 \) respondents) indicated a willingness to pay between ~$2 and ~$10 per punnet, the average being ~$5 per punnet; which on the day was comparable with strawberries.

Figure 2. Project staff member Khamla Mott (LHS) conducting consumer survey at Fine Fruit on James in Fortitude Valley, Brisbane (image by M. Cover).
2. Business plan for commercialisation

Although Australian fresh produce and food processing companies were reluctant to invest in a completely new fruit, Australian growers and a plant nursery are keen to become involved in Red Bayberry production (see Trials and methods). Through pilot scale production and with a focus on capturing return on investment by value chain members, the model based on the best Australian Red Bayberry germplasm (Appendices 2, 3 and 4) would be comprised of researcher, propagator, grower and marketer partners facilitated by commercialisation acumen.

To this end, a proposed follow-on project entitled ‘Pilot production and sales of Red Bayberry in Australia’ (Project PRJ-005083) has been submitted to RIRDC. In the context of the business plan, the objectives of the proposed project are: selection of additional superior Australian Red Bayberry clones for ornamental plant and fruit quality characteristics; IP protection (PBR or Trade Marking) of selected Red Bayberry clones for commercialisation; commercial scale propagation of selected superior Red Bayberry clones for commercial trialling in Queensland and Northern New South Wales; pilot scale commercial scale trial plantings on grower’s properties of Red Bayberry trees for fruit production; refinement of agronomic (e.g. pollination, pruning and thinning) practices for Red Bayberry trees; protocols for post-production Red Bayberry fruit packaging, handling and marketing; and, pilot scale test marketing of fruit from selected Red Bayberry clones. The core partners, along with growers expressing an interest in membership of a ‘Growers Club’ plus a supermarket retailer, would be UQ (research), Birdwood (nursery) and UniQuest (commercialisation).

3. Elite cultivar

Bringing an elite Red Bayberry cultivar into Australia from China proved problematic (see Trials and methods). Similarly, attempts to obtain other lines from Florida and Japan encountered prohibitive logistical difficulties. Nonetheless, several promising female (fruiting) cultivars were successfully selected from within germplasm held at UQ (Appendices 2, 3 and 4).

Female lines N1MR6 and 9 were judged particularly promising on the basis of agronomic, including yield, characters (Appendices 2 and 3; Figure A3.2; Figure 3), as well as by consumer acceptance (see above). Male lines N1MR1 and 10 will be maintained as pollinators.

Figure 3. **N1MR9 Red Bayberry fruit harvested at Maroochy Research Station in 2010 (image by K. Mott).**
In follow-on project work, these four lines will be multiplied-up for pilot scale production trials on grower’s properties at a range of locations down the eastern seaboard of Australian. Red Bayberry can be difficult to reproduce vegetatively, but preliminary work at UQ and Birdwood has demonstrated successful adventitious rooting of cuttings and grafting of buds onto seedling rootstocks.

Young trees (N2MRx series) cropped for the first time in 2009 and five female trees (x = 9, 24, 29, 34 and 99) exhibited promising fruit characteristics (Appendix A3.5).

4. Trial plantings

Red Bayberry plants were grown in-ground in Queensland (Nambour, Gatton) and Victoria (Silvan, Tatura). The most promising site was the sub-tropical Maroochy Research Station (MRS) at Nambour, where all N1 (older plants) and N2 (younger plants) Red Bayberry germplasm flourished ( Appendices 2, 3, 4 and 5). Potentially good performance at this site was predicted on the basis of climate mapping (Joyce et al. 2005).

In Victoria and as of March 2010, there were four seedling Red Bayberry trees at the DPI-Vic research station near Tatura (Figure 4) and seven and four N1MR series trees, respectively, on strawberry farms near Silvan belonging to Henry Kita (Figure 5) and John Stewart (Figure 6). All Red Bayberry plants in Victoria established slowly and among those that survive, their rates of growth were very slow compared to trees at MRS and none of these 15 plants have flowered to date.

Figure 4. Four Red Bayberry plants photographed in 2010 at ~7 years old from seed at DPI Victoria research station at Tatura, Victoria. (Note: The first plant was debilitated in association with damage at the base of the trunk).
The N1 series Red Bayberry genotypes (Figure 7) planted-out at MRS in September 2005 fruited for the first time in 2007 (Appendix 3). They had been previously held in pots under shadehouse conditions at UQ Gatton for 1 to 2 years. In 2008 for tree N1MR9, approx. fruit number, yield and av. fruit wt were 7,349 fruit, 36 kg and 4.9 g, respectively (Table A3.1).
Figure 7. Two of 12 N1 series (older; cf. Figure 7) Red Bayberry plants photographed in 2008 at ~3 years old in-ground from cuttings at Maroochy Research Station at Nambour, Queensland.

The N2 series of Red Bayberry genotypes (Figure 8) were planted-out at MRS in September 2006 as young (~1 year old) seedlings. Both some male and female plants flowered and fruited (female) for the first time in 2009 (Appendix 3). Some of the female lines were assessed to possibly have commercial potential; viz. N2MR9, 24, 29, 34 and 99.

Figure 8. Part of two rows comprising 141 N2 series ('younger'; cf. Figure 6) Red Bayberry plants photographed in 2008 at ~2 years old in-ground from seed at Maroochy Research Station at Nambour, Queensland (image by Q. Son Dinh).

General agronomic guidelines for Red Bayberry trees are offered in Appendix 4. Overall, the vigorous trees were generally easy to grow in the open towards the bottom of an east facing slope at MRS. They required little fertiliser and irrigation only in months when rainfall was inadequate.
(Appendix 3). The plants were in a red Earthy Podzolic. Roots growing through surface organic mulch appeared to naturally develop mycorrhizal associations and looked to be infected with potentially N-fixing *Frankia* (Appendix 5). Minor insect pests observed were a leaf-rolling tortricidae caterpillar and two scales, Nigra and Soft Brown. A debilitating disorder that may possibly be pathogenic or nutritional was observed to afflict two of the younger trees. Fruit are attractive to birds and so trees need to be netted at harvest time in late October early November. Fruit are harvested fully ripe and, being delicate, need to be packaged and handled with the care afforded soft berry crops, like raspberry.
Implications

The primary goal of this project was to establish the potential for Red Bayberry production and sales in Australia. This overall objective was approached through four inter-related activities of ascertaining Australian consumer acceptance of the fresh fruit, establishing a plan for commercialisation of Red Bayberry in Australia, obtaining elite germplasm and trialling *Myrica rubra* at diverse locations. Modification to specific aspects of each individual activity was necessary over the course of this low level, long term (5-year) project. However, the project provided clear evidence of the potential for fresh fruit production and sales here in Australia.

Consumer surveys revealed that Australians like fresh Red Bayberry fruit and are interested in it being available for purchase. Lines of Red Bayberry similar to the elite Biqi cultivar in China were identified within seed-derived germplasm in Australia. Plants were grown in temperate Victoria and in sub-tropical Queensland. As fruit developed much faster in Queensland, a commercialisation alliance was formed to establish pilot scale production of Red Bayberry fruit in Queensland and New South Wales.

As a result appropriate for the RIRDC New Plant Products program, Red Bayberry is now positioned to become a recognised new ‘berry fruit’ crop for sale in Australian fresh fruit and vegetable outlets within the next 5 to 10 years. This time line may seem long, but is not at all unreasonable for a difficult to propagate tree fruit crop with a juvenile period in order of 3+ years. As initially intended, individuals and organisations participating in the project will form the core of a value chain for production and marketing of the fruit. These parties, UQ, UniQuest and ANFIC member nursery Birdwood, will work with volunteer ‘Grower Club’ members and a co-opted supermarket retailer to produce and sell fresh Red Bayberry fruit in Australia.
Recommendations

Based on the achievements of Project PRJ-000527 ‘Commercial potential of Red Bayberry in Australia’ it is recommend that RIRDC co-invest with research (UQ) and industry organisations (Birdwood, UniQuest) in a proposed follow-on project entitled ‘Pilot production and sales of Red Bayberry in Australia’. Activities within this subsequent project would be to: select additional superior Australian Red Bayberry clones; secure IP protection of clones selected for commercialisation; vegetatively propagate selected superior Red Bayberry clones for commercial scale trialling; establish pilot scale trial plantings on grower’s properties; refine agronomic practices (e.g. pollination, pruning and thinning); prescribe protocols for post-production fruit packaging, handling and marketing; and, pilot-scale test-market fruit of the selected female clone/s.
Appendices

Appendix 1. Abstracts from and references for consumer surveys on imported (3.1) and local (3.2 and 3.3) Red Bayberry fruit of Biqi heritage.


“A preliminary study was undertaken to gauge acceptance of fresh Red Bayberry (*Myrica rubra*) fruit from China by consumers not familiar with the crop. Fruit imported into Australia were assessed for appearance, flavour, and mouthfeel. Untrained panellists (*n* = 17) rated the fruit on a linear 9-point hedonic rating scale from 1 (dislike extremely) to 9 (like extremely), the midpoint being neither like nor dislike. The fruit were generally well accepted, gaining mean scores of 7.2, 6.9, and 6.7 for appearance, flavour, and mouthfeel, respectively. The panellists suggested that fresh Red Bayberry fruit were berry-like and, in particular, mulberry-like. The fruit was considered attractive and juicy, with an agreeable sugar/acid balance and an appealing unusual mouthfeel. These findings suggest that fresh Red Bayberry fruit may be acceptable to consumers in countries other than their native China.”


“This report presents findings from a series of consumer focus groups that were designed to collect data on initial reactions, perceptions and expectations of red bayberries. Sixty-one consumers, who were frequent berry consumers and willing to try new foods, attended one of seven focus group sessions in November 2008. The consumers individually assessed four Red Bayberry samples for a number of hedonic (likability) attributes. Discussions on a range of focus group questions were completed initially on the appearance of the Red Bayberry (before tasting) and after assessments were completed. The N1MR 7, N1MR 9 and N1MR 6 Red Bayberry samples received the highest likability scores (for overall, appearance, flavour, texture and aftertaste likability) which were not significantly different from each other (*P* > 0.05). Samples N1MR 7 and N1MR 9 were liked overall significantly more (*P* < 0.05) than the N1MR 2 sample. The N1MR 2 sample was consistently the least liked for all of the attributes assessed receiving acceptability mean sensory scores corresponding to ‘neither like nor dislike’. During post tasting discussions, most of the participants seemed to respond positively to the berry's sensory attributes. Consumers liked dark red fruit which was big and plump. The texture was generally well liked and was described as juicy, ‘explosive’, plump and fleshy. Consumers liked the intense strong flavour and the favourable sweet: tartness balance and associated aftertaste which mellows. Negative fruit associations included pale fruit, which was thought to be unripe, and the presence of the seed. Some consumers did not like the flavour as it was too tart and the aftertaste too strong. Based on appearance, more consumers associated the Red Bayberry with lychee (and not blueberries, strawberries and raspberries) due to the appearance of a harder, inedible skin and seed, the preparation required for consumption and a hard, firm texture. The Red Bayberry and lychee were exotic and less familiar. Before tasting, the consumers indicated that they would choose Red Bayberry before other fruits in a store based on interest in a new fruit and curiosity. These responses were reiterated when asked in general how they felt when they saw a new fruit on the shelf. Consumers were willing to try either as part of an in-store tasting demonstration or buy a few to take home. Price was mentioned as an important factor both before and especially after tasting. After tasting, the consumers were also concerned with fruit quality and freshness, presentation and the shape and the size of the berries. Most consumers indicated that they would prefer bigger fruit as it would have more flesh, better value for money, increase ease of use (preparation for other applications) and that a smaller or no seed was preferred. However, some consumers specifically indicated not to make the fruit bigger and could see no advantages in doing so. The red/purple spectrum of colours was the most favoured and associated with ripeness and flavour. Some liked the
proposition of a white berry whereas others did not. Some liked the idea of a range of fruit colours. Consumers identified with eating the red bayberries whole and fresh. They were thought to have potential on cheese and fruit platters to add a lot of visual impact and variety. Applications in smoothies, yoghurts, ice-cream and dessert were raised as well as in alcoholic beverages. Processing (e.g. frozen, juiced, dried) was thought to increase applications out-of-season and provided convenience options. Consumers expected to see the red bayberries located in the berries section in supermarkets, gourmet shops and delicatessens and fruits stores. They would like to purchase the berries fresh in strawberry or blueberry sized punnets or frozen. Loose red bayberries were a favourable option for some to allow selection as required whereas others specifically were against this option due to potential handling damage. Information requested at point-of-sale included nutritional information, health related aspects, origin, storage history, application and serving suggestions. The most frequent responses regarding price were $4-6 for a strawberry sized punnet. Potential marketing targets were thought to be gourmets, ‘foodies’ and middle/high income earners, parents, shoppers, families and health conscious consumers. TV advertisements and daytime cooking shows, magazines, in-store demonstrations, health food stores and markets/delis were seen as appropriate for marketing the fruit. When asked to suggest names for marketing this fruit in Australia many identified with its seasonality. The association with Christmas time and likeness in appearance to tree decorations was mentioned in several groups. Other names were put forward but nothing else repeated. There was an overwhelming dislike for the name Love berry with many describing it as off-putting, tacky and suggestive of aphrodisiac properties. Preferences were split for the remaining options of Bayberry, Red Bayberry and Chinese Bayberry. Nobody that took part in the focus groups had any previous experience with this fruit.”


Table A1.1. Red Bayberry samples for chemical evaluation.

<table>
<thead>
<tr>
<th>Variety</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>N1MR2</td>
<td>Maroochy Research Station</td>
</tr>
<tr>
<td>N1MR6</td>
<td>Maroochy Research Station</td>
</tr>
<tr>
<td>N1MR7</td>
<td>Maroochy Research Station</td>
</tr>
<tr>
<td>N1MR9</td>
<td>Maroochy Research Station</td>
</tr>
</tbody>
</table>

Table A1.2. Weights calculated for Red Bayberry during sample preparation.

<table>
<thead>
<tr>
<th>Variety</th>
<th>Whole Fruit Wt (g)</th>
<th>Symbio Wet Flesh Wt (g)</th>
<th>IFT Wet Flesh Wt (g)</th>
<th>IFT Dry Flesh Wt (g)</th>
<th>Seed Wt (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>N1MR2</td>
<td>286</td>
<td>N/A</td>
<td>228</td>
<td>23</td>
<td>52</td>
</tr>
<tr>
<td>N1MR6</td>
<td>685</td>
<td>N/A</td>
<td>599</td>
<td>57</td>
<td>79</td>
</tr>
<tr>
<td>N1MR7</td>
<td>606</td>
<td>200</td>
<td>356</td>
<td>35</td>
<td>59</td>
</tr>
<tr>
<td>N1MR9</td>
<td>990</td>
<td>200</td>
<td>661</td>
<td>67</td>
<td>122</td>
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</table>
### Table A1.3. Moisture content and dry weights calculated for Red Bayberry samples.

<table>
<thead>
<tr>
<th>Variety</th>
<th>Moisture content of berry (g/100g)</th>
<th>Dry weight (g/100g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>N1MR2</td>
<td>90.5</td>
<td>9.5</td>
</tr>
<tr>
<td>N1MR6</td>
<td>91.0</td>
<td>9.0</td>
</tr>
<tr>
<td>N1MR7</td>
<td>90.8</td>
<td>9.2</td>
</tr>
<tr>
<td>N1MR9</td>
<td>90.4</td>
<td>9.6</td>
</tr>
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</table>

### Table A1.4. Red Bayberry compositional analyses.

<table>
<thead>
<tr>
<th></th>
<th>Units</th>
<th>N1MR7</th>
<th>N1MR9</th>
<th>N1MR6</th>
<th>N1MR2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Vitamins</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B3 (Niacin)</td>
<td>mg/kg</td>
<td>2.8</td>
<td>1.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B9 (Folic acid)</td>
<td>mg/kg</td>
<td>0.01</td>
<td>0.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B12 (Cyanocobalamin)</td>
<td>mg/kg</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A (Retinol)</td>
<td>IU/g</td>
<td>&lt;10</td>
<td>&lt;10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E (Tocopherol)</td>
<td>IU/g</td>
<td>&lt;10</td>
<td>&lt;10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C (Ascorbic acid)</td>
<td>mg/100g</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Elements</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Al</td>
<td>mg/kg</td>
<td>1</td>
<td>3.5</td>
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<td></td>
</tr>
<tr>
<td>B</td>
<td>mg/kg</td>
<td>&lt;2</td>
<td>&lt;2</td>
<td></td>
<td></td>
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<tr>
<td>Ca</td>
<td>mg/kg</td>
<td>157</td>
<td>80</td>
<td></td>
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</tr>
<tr>
<td>Cu</td>
<td>mg/kg</td>
<td>0.52</td>
<td>0.34</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fe</td>
<td>mg/kg</td>
<td>5.2</td>
<td>6.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zn</td>
<td>mg/kg</td>
<td>1.4</td>
<td>1.1</td>
<td></td>
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</tr>
<tr>
<td>Mg</td>
<td>mg/kg</td>
<td>103</td>
<td>78.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P</td>
<td>mg/kg</td>
<td>60.3</td>
<td>51.7</td>
<td></td>
<td></td>
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<tr>
<td>K</td>
<td>mg/kg</td>
<td>1280</td>
<td>1220</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Na</td>
<td>mg/kg</td>
<td>21</td>
<td>24</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mn</td>
<td>mg/kg</td>
<td>11.9</td>
<td>4.85</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S</td>
<td>mg/kg</td>
<td>139</td>
<td>130</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TEAC (antioxidant)</td>
<td>mg Gallic acid equivalents/100g FW</td>
<td>49.6</td>
<td>33.6</td>
<td>52.4</td>
<td>59.0</td>
</tr>
<tr>
<td>Total phenolics</td>
<td>mg Gallic acid equivalents/100g FW</td>
<td>113.9</td>
<td>78.1</td>
<td>113.0</td>
<td>131.9</td>
</tr>
</tbody>
</table>

<p>| <strong>Carotenoids</strong>   |              |       |       |       |       |
| Lutein            | µg/100g FW   | 14.2  | 6.8   | 12.9  | 16.2  |
| Zeaxanthin        | µg/100g FW   | 2.5   | 1.6   | 2.2   | 2.4   |
| Beta-cryptoxanthin| µg/100g FW   | 4.1   | 2.9   | 4.0   | 4.5   |
| Beta-carotene     | µg/100g FW   | 11.8  | 5.6   | 12.4  | 12.2  |</p>
<table>
<thead>
<tr>
<th>Lycopene</th>
<th>µg/100g FW</th>
<th>Not detected</th>
<th>Not detected</th>
<th>Not detected</th>
<th>Not detected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sugar profile (by fresh weight)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>fructose</td>
<td>g/100g FW</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.1</td>
</tr>
<tr>
<td>glucose</td>
<td>g/100g FW</td>
<td>0.8</td>
<td>0.9</td>
<td>0.8</td>
<td>0.9</td>
</tr>
<tr>
<td>sucrose</td>
<td>g/100g FW</td>
<td>4.3</td>
<td>4.9</td>
<td>4.2</td>
<td>4.0</td>
</tr>
</tbody>
</table>

“Considered collectively, comments on appearance, flavour and texture provided by consumers who did not have prior knowledge of the fruit suggest that fresh Red Bayberry constitutes an acceptable and somewhat unusual sensory experience. Overall scores suggest that, from the participating Australian consumer’s perspective, Red Bayberry fruit are attractive, have an agreeable taste, and feature a novel texture. Regarding price point, the information gathered suggests that consumers would be prepared to pay on ~$5.10 per 250g punnet for red bayberries. While further work could be conducted to explore broader cross sections of the Australian community, the results of the present study should encourage potential growers and marketers to invest in this novel crop.”

Update No. 1 (2005):

Contact / meetings with (potentially) interested industry: Contact has been made with staff of - 1. Growcom (Richard Ross [Mgr., Grower Services]; mtg.) – no subsequent interest. 2. NuPlant (Dr Bob Teasdale; mtg. 11.6.05) – no subsequent interest. 3. Birkdale Nursery (James and Barbara McGeogh [owners]; mtg. 11.08.05) – provided letter of support to Birkdale Nursery from UQ for the import via AQIS of two elite Red Bayberry cvs. 4. Grove Fruit Juice (Brett Attridge [Mkting.] and David Milton [G.M.]; mtg. 14.9.05; introduced by Cameron Turner, QDSDT&I) – expressed interest in obtaining samples of frozen Red Bayberry fruit to examine the juice characteristics. 5. Golden Circle Pty. Ltd. (Val Tanguilig; e-mail) – no subsequent interest. 6. Australian Nurserymen’s Fruit Improvement Company {ANFIC} (Dr Gavin Porter; mtg. 4.10.05) – industry collaborator*

Contact / meetings with potentially interested researchers: Peter Hofman, QDPI&F Horticulture (10.8.05) – discussion re trial planting at Maroochy Research Station and later market survey work. Dave Brown & Derek Foster, QDPI&F Rural Industries Business Services Group (17.11.05) – discussion re garnering grower interest. Ian Ferguson (HortResearch NZ.; 1.12.05) – discussion re New Zealand’s interests / progress in developing Red Bayberry as a crop there.

Contact with collaborators in China: 1. Professor Li Jiangrong of Hangzhou University of Commerce (Hangzhou, Zhejiang Province) was contacted and asked to kindly determine a source of fresh-frozen Red Bayberry fruit for taste testing#. He has obtained consent in principle from Haitong Food Company (Cixi, Zheijiang Province). 2. Professor Yueming Jiang (South China Institute of Botany, Guangzhou, Guangzhou Province) and Professor Shenggen He (Zhongkai University, Guangzhou, Guangzhou Province) are interested in conducting collaborative postharvest studies with Red Bayberry fruit in China.

Vegetative propagation of Red Bayberry plants: Twenty seven (27) plants have been grown in 20-cm pots and 85 in 10-cm pots at the UQ Gatton Plant Nursery Unit from cuttings taken from 12 seedlings (presumed Biqi fruit) brought to Queensland from Victoria by the CI prior to commencement of this project. These will be planted out for field evaluation in subsequent years of this project.

Sexual propagation of Red Bayberry plants: Two hundred and eighty four (284) seedlings are being grown in 4-cm tubes at the UQ Gatton Plant Nursery Unit from (presumed Biqi fruit) seed imported from China prior to commencement of this project. They will be evaluated after the juvenile period for their fruit characteristics.

Initial trial planting: The 12 2-year-old Red Bayberry plants originally brought to Queensland were planted out in the field at DEEDI’s Maroochy Horticultural Research Station (15.9.05).

Scion wood import: Scion wood from known male and female plants was imported with assistance by ANFIC from the University of Florida. The purpose was to make sure of a known pollinator (i.e. male). AQIS misplaced the imported material for ca. 1 week, after which time the bud sticks were in poor condition. DEEDI Plant Quarantine was only able to get one female plant from a bud grafted onto seedling rootstocks provided from UQ Gatton.

Update No. 2 (2006):

Since the preceding (first) progress report the main activities in this project have been: 1. Growing-on of young seedling Red Bayberry plants at the UQ Gatton Plant Nursery. 2. Maintenance of older seedling plants and their vegetative propagation at the UQ Gatton Plant Nursery and planting-out of trial trees at Nambour. 3. Making arrangements for the import from China of fresh Red Bayberry
fruit for taste testing. 4. Discussions with the Queensland Department of Primary Industries and Fisheries concerning increased involvement in this project.

Growing-on of young seedling Red Bayberry plants at the UQ Gatton Plant Nursery: Approximately 170 vigorous Red Bayberry plants (see image below) were produced in the 1st year of this project from seed previously imported from China under AQIS permits. These plants were grown to about 30-cm in height under shadehouse conditions at the UQ Gatton Plant Nursery. All of these seedlings have been moved to the DEEDI’s Maroochy Research Station at Nambour for planting out.

Maintenance of older seedling plants and their vegetative propagation at the UQ Gatton Plant Nursery and planting-out of trial trees at Nambour: Older seedling plants produced prior to commencement of this project have been maintained and used as a source of propagation material (i.e. cuttings) for production of a series of generations of plants that can be used as rootstocks as and when required.

Second generation young plants were planted out in the field at DEEDI’s Maroochy Research Station last spring 2005 and have established and grown rapidly. Nambour was previously identified on the basis of climate mapping conducted in the course of the first RIRDC Red Bayberry project as a likely suitable location for Red Bayberry production.

Arrangements for import from China of fresh Red Bayberry fruit for taste testing: Mr Craig Firrell has been engaged by the project team to co-ordinate the import of fresh Red Bayberry fruit. AQIS has advised that import of fresh Red Bayberry fruit cannot be approved. However, AQIS has agreed that fresh Red Bayberry fruit may be imported to an approved facility for taste testing prior to their destruction. Fresh fruit are currently available in China and the project team is awaiting receipt from AQIS of approval to import under this condition. [As indicated in the first project report, the default approach will be to try to import fresh frozen fruit, with AQIS approval, for taste testing.] Contact information for key players in the fresh fruit importation activity is provided below*. An assessment form for use by untrained tasters has been prepared by Dr Peter Hofman, QDPI&F.

*List of Contacts: Exporter - Mr. Jian Zhong OuYang, Conghua Hua Long Fruit and Vegetable Fresh’en Ltd., Shenggan Town, Gonghua City, Guananghu, China, E-mail oy89@21cn.net. Importer - John Guy, Vision International, Pinkenba, Brisbane, Phone (07) 38667900, Fax (07) 32602455. AQIS - Nadija Kobelke, Canberra, Phone (02) 62725357, Fax (02) 62723745. AQIS - Allen Self, Brisbane, Phone (07) 32468765.

Discussions with DEEDI (formerly QDPI&F) concerning increased involvement in this project: By way of background, the first RIRDC Red Bayberry project was co-ordinated by Mr Graeme McGregor of DPI-Victoria. The first project generated RIRDC Publication No. 05/081: ‘Red Bayberry – A New and Exciting Crop for Australia’. Mr McGregor was not a formal member of the team working on this follow on project because of worsening illness. However, his advice as a reputed plant breeder and his personal interest was to be utilised informally. Sadly, Mr McGregor passed away in the course of the first year of this project. Consequently, the co-ordinator of the current project investigated the potential interest of DEEDI plant improvement experts in becoming formally involved. Consultations with Dr Vicki Lane of DEEDI have led to another reputed plant breeder, Dr Garth Sanewski, kindly agreeing to take a guiding role in the present project. Dr Sanewski is based at Maroochy Research Station, Nambour. An agreement between DEEDI and UQ is currently being drafted by DEEDI for consideration by stakeholders as part of a proposed project variation. The outcome of this variation is anticipated to be additional expertise coming into the project that will result in a major strengthening of the germplasm program. This variation would be sought within the current budget and thus not constitute an additional cost-burden. Thus, in due course, a formal request for variation would be submitted to RIRDC.

Update No. 3 (2006):
The main activities in this stage of the project have been: 1. Planting-out and establishment of young seedling plants at DEEDI Maroochy Research Station (MRS). 2. Import from China of fresh Red Bayberry fruit for taste testing. 3. Provision of a draft trialling agreement to Victorian strawberry growers via DPI – Vic. (C/- Dr Robert Premier) for consideration and sign-off prior to sending RBB seedlings trial plantings near Silvan in the Dandenong Ranges.

The first seedlings were planted on Maroochy Research Station in 2005. There is no cropping after 1 year, but the trees are vigorous having reached 2-3 m in that time. Trees are producing 20-30 cm per flush and three flushes are expected over the growing season. There is considerable variation in tree form from dense and compact to upright and open. There is little pest damage at this stage, only a small amount of caterpillar and leaf roller damage.

One hundred and forty seedlings were planted in a location on Maroochy Research Station that receives more frost than does the older trees in an effort to provide more chilling. This location is also under the protection of bird and hail netting. These seedlings are close planted and trained to a single stem in an effort to encourage earlier cropping (see photo below).

Contact has been made with the National Institute of Agrobiological Sciences in Japan and established that four Japanese varieties of Red Bayberry (Juro, Akadango, Shiratae and Gozen) are available for importation. The necessary quarantine paperwork is being completed to initiate this importation.

**Update No. 4 (2007):**

Market pull: AQIS could not allow import of Red Bayberry fruit for general consumer evaluation. However, limited taste-testing at their Quarantine Premises in Brisbane was permitted. The fresh fruit were rated very highly by panellists. A published report is available C/- d.joyce@uq.edu.au. Steps are underway towards importing fresh-frozen fruit for more extensive consumer evaluation.

Production push: To date, China has not allowed export of elite Red Bayberry germplasm. However, scion material has been sourced from the USA and Japan to be grown-on for evaluation. Also, >100 seedlings are being grown-on at Maroochy Research Station by Garth Sanewski (DEEDI). What seem to be flower buds have appeared on some large seedling trees. Seedlings have also been provided, via Robert Premier (DPI-Vic), for evaluation in Victoria. Relationships with China are being strengthened concerning information on cultural practices. Seedlings established at UQ Gatton are being propagated for provision as rootstocks for imported scion material at MRS and for growing-on in NSW (c/- Gavin Porter).

While external factors have influenced the project and necessitated a shift to later in the project of the business plan, the aim of investigating the commercial potential of Red Bayberry in Australia is being realised effectively.

**Update No. 5 (2007):**

Business Plan - Red Bayberry trees produced fruit for the first time in November 2007. The project has evolved over time in the light of acquired knowledge and experience. The Red Bayberry project has evolved to having both important ‘production push’ and ‘market pull’ aspects. It was initially planned to engage an outside consultant to prepare a business plan for Red Bayberry production. In this context and following informal consultation with production and marketing experts [Dr Gavin Porter (Australian Nurseryman’s Fruit Improvement Co., ANFIC, Bathurst; fruit crop breeding and production), Dr Garth Sanewski (DEEDI, Nambour; fruit crop breeding and production), Mr Cameron Turner (UniQuest Pty. Ltd., Brisbane; Business Development), Prof. Sherrie Wei (Supply / Value Chains; Dept of International Business Administration; Chienkuo Technology University, Taiwan)], the following strategy was instead adopted.
Engender a production push - 1. Garner production information from China: Dr Garth Saneswski, Prof. Sherrie Wei (a Chinese speaker) and Prof. Daryl Joyce visited Zhejiang Province in China in October 2007* and met with Red Bayberry producers and processors. The team also met with researchers undertaking pre- and postharvest research on Red Bayberry. The findings will be incorporated in a publication for potential Australian growers. 2. Publish Red Bayberry production information in fact sheets and/or in an Australian industry magazine: The information from the abovementioned visit to Zhejiang will be included along with initial Red Bayberry growth and fruiting data at Maroochy Research Station (MRS) into a publication aimed at stimulating interest among potential growers in Australia. 3. Engage regional ANFIC representative/s: Having determined in November 2007 that Red Bayberry plants will flower and set fruit in the Nambour region, talks will be initiated with regional ANFIC nursery members concerning the acquisition and / or selection of elite fruiting cultivars, agronomy and other matters.

Engender a market pull - 1. Determine source/s of processed fruit from China: Dr Garth Saneswski, Prof. Sherrie Wei (a Chinese speaker) and Prof. Daryl Joyce visited Zhejiang Province in China in October 2007* and met with a major Red Bayberry processor that exports Red Bayberry products. The Haitong group agreed to co-operate in providing Red Bayberry products for assessment in Australia. 2. Determine user/s of processed product in Australia: Mr Cameron Turner and Prof. Daryl Joyce met with a Brisbane-based company that imports raw materials from China. The Food Spectrum group agreed to co-operate in testing processed Red Bayberry product/s from China.** 3. Conduct consumer evaluation in Australia: Following on from a limited, but favourable, taste panel assessment (in AQIS facilities at Brisbane Airport) of imported fresh Red Bayberry fruit, wider consumer evaluation of Red Bayberry is to be undertaken. It is intended that imported processed (e.g. fresh frozen, juice) will be evaluated by a panel organised by Food Spectrum and also with the general public, probably in a shopping centre/s. The results of limited taste testing of fresh fruit from seedling trees at MRS will soon be available, and these results will provide insight for organising broader consumer taste testing on the second (2008) crop.

It is envisioned that this Business Strategy will create confidence in producers to invest in fresh Red Bayberry fruit production and consumers to purchase processed (initially) and fresh (in due course) Red Bayberry products.

Notes: * The information gathering trip to China was funded as follows: The RIRDC project contributed the costs of international airfares and minor incidentals (G.S., S.W., D.J.). The participant’s organisations contributed their time at no cost to the project. Third parties (academic, industry) contributed all (i.e. accommodation, food, regional travel) in-country costs. Professor Li Jianrong in particular is thanked for his generous support as a host and colleague. ** In the wake of the China visit, importation of processed Red Bayberry is currently being negotiated with Haitong (China) and Food Spectrum (Australia).

Update No. 6 (2008):

Foci over the Summer-Autumn growing season since the last bayberry project report have been to: maintain the original 12 seedling stock plants (i.e. vegetatively re-propagate) held at The University of Queensland Gatton campus (UQG) and the allied initial planting of one maturing tree of each of these genotypes at DEEDI Maroochy Research Station (MRS); and, maintain the second planting-out of approx. 140 seedlings for germplasm evaluation and selection at MRS. Growth is vigorous and there have not been any plant losses. Moreover, both the 12 established trees and many of the germplasm selection seedlings have already formed what appear to be flower buds for the 2008 fruiting season. Also, it has been established in root studies that nodules are present on both the nursery and the field trees at UQG and MRS, respectively. These nodules are indicative of natural inoculation probably by the nitrogen-fixing organism Frankia. Accordingly, it is unlikely that artificial root inoculation will be needed in Australia. Finally, a consignment was organised for Chinese Red Bayberry juice to be
sent from China (Haitong Food Company) to Australia (Food Spectrum Pty. Ltd.) for trialling with clients. The aim is to create in Australia market pull to compliment production push.

Update No. 7 (2009):

Principle activities this year were to maintain: Twelve seedling RBB stock plants held at UQ Gatton campus nursery (re-propagate) along with a matching set of mature RBB trees at DEEDI Maroochy Research Station (MRS); and, ~140 immature RBB seeding trees at MRS for future germplasm evaluation. Growth was vigorous and there were no plant losses. At MRS, female genotypes NMR2, 6, 7 and 9 fruited heavily. Averaged fruit number, tree yield and individual fruit weight were ~8,300, ~38 kg and 4.5 g, respectively. Because of excessive set, fruit were generally small and tightly clustered. NMR2 produced small and pale fruit, which matured later than other trees. NMR7 produced fruit that were a reasonable size, dark and with good flavour. NMR9 produced a good yield of bright red fruit. NMR6 produced a good yield of dark red fruit. NMR5 produced an insignificant quantity of large, dark fruit. Focus groups yielded information on initial consumer reactions, perceptions and expectations of RBB. NMR 7, 9 and 6 fruit received the highest likability scores for overall, appearance, flavour, texture and aftertaste, and were not significantly different from one another. NMR 7 and 9 were, however, liked overall significantly more than NMR 2.

Update No. 8 (2009):

Flowering and fruiting of 12 older seedling trees again occurred up to harvest in November 2009. NMR9 performed consistently well, with good yields (~34 kg) of quality fruit, and appears to have significant commercial potential. Lower than previous season cropping on some female seedlings suggests a requirement for fruit thinning to avoid biennial bearing. Fresh NMR6 fruit were presented for tasting by ~100 shoppers selected at random at a fruit shop near Brisbane CBD. Overall, shoppers liked Red Bayberry fruit; with most expressing the view that they would purchase them as they do strawberries and other berry fruit. Flowering was observed for the first time among 141 younger seedlings that had been planted-out in September 2006. They were treated with paclobutrazol in April, 2009. Of these, 59 flowered; and 29 were males and 30 females. Some diversity of fruit characteristics was evident. Fruit size and fruit number varied considerably between trees; and, fruit colour and flavour also varied. Superior types among this younger set of seedling will be selected for clonal multiplication in due course. Seed was collected for potential production of rootstocks. In this regard, trials examining a range of seed treatments aimed at overcoming physiological dormancy were established.

Commercial cropping and sales potential in Australia of Red Bayberry have now been fully established. With industry partners Birdwood (nursery) and UniQuest (commercialisation), a PRP seeking ongoing support to facilitate pilot scale Red Bayberry production has been submitted to RIRDC for consideration. This proposal was initially put to HAL; but, was returned with advice that RIRDC is the more appropriate agency for this new horticulture crop.

A press release was issued by UQ-UniQuest in the November 2009 fruiting season (see attachment). Media response was strong, with several interviews resulting on state and national ABC radio stations and also with state (e.g. Courier Mail) and national (e.g. Good Fruit and Vegetables) print media. The consumer survey also constituted a positive promotional activity (see attachment). Expressions of interest from established horticulture farmers along the eastern seaboard from the Atherton Tablelands in the north to the mid-north coast of NSW were recorded for potential involvement in pilot scale Red Bayberry work.

Strong support has continued from the Australian Nuseryman's Fruit Improvement Company (ANFIC), C/- Dr Gavin Porter. Importantly, ANFIC member nursery, Birdwood (near Nambour) has germinated Red Bayberry seed and grown-on plants as seedling rootstock material. Mr Peter Young of Birdwood demonstrated that Australian scion material can be successfully grafted onto seedling
Seeds and vegetative material were provided to Birdwood under a Material Transfer Agreement (MTA) to protect all stakeholders, including future Red Bayberry producers.

A PhD student (Ursula Steinfort) funded by a Chilean scholarship has recently (November, 2009) been recruited to assist with planned work on the physiology of vegetative propagation for rapid multiplication of elite Red Bayberry selections via cuttings and in tissue culture.

Update No. 9 (2010):

This is the final progress report on PRJ-000527. Since the 2009 report, 12* mature cloned seedling Myrica rubra (MR) trees (N1 series) and 141* maturing seedling trees (N2) were maintained at Maroochy Research Station (MRS), Nambour. Germplasm of N1MRx trees at MRS was also maintained at Gatton (GMRx). All N1 trees remained healthy, but two N2 trees developed stem cankers. Among N1 genotypes, N1MR6 and 9 were elite fruiting lines and N1MR1 and 10 were pollinator lines. Of N2 seedlings, 26 were female and 29 male; the others not yet flowering. Of the females, N2MR9, 24, 34, 29 and 99 were promising for initial fruit yield and quality. A further 4* immature seedling trees (T1 series) were maintained at the Institute of Sustainable Irrigated Agriculture, Tatura; and 7 and 4, respectively, cloned immature trees (N1 series) were maintained on two strawberry grower’s (Henry Kita, John Stewart) properties at Silvan (Victoria). All trees in Victoria, except 1 T series tree, were healthy. [* indicates unique seedling genotypes.] Untrained consumer tasting (n=126) of N1MR9 fruit in November 2009 indicated that Red Bayberry fruit are attractive, have an agreeable taste, feature a novel texture and should be packaged and priced as per berries.
Appendix 3  Notes on aspects of agronomy for Red Bayberry (by Dr Garth Sanewski).

A3.1. Observations in early 2007 for Red Bayberry plants at MRS (Maroochy Research Station, Mayers Rd., Nambour, Qld.):

“Two plantings of Red Bayberry exist on Maroochy Research Station. The first planting was made in September, 2005 and the second in September, 2006. All are (derived from) seedlings from seed imported from China and raised at the University of Qld. All trees have grown well demonstrating good growth potential under irrigated conditions. The first planting was made at a wide spacing and these trees have not been pruned. The second planting was made in a cooler site at a close planting. In an effort to encourage earlier fruiting these trees were pruned to a central terminal to 2 m before being allowed to branch.

Phenology: The first signs of what appears to be flower buds appeared in a small percentage of 20 mth old trees on MRS in early April. In most cases these buds are mostly in the leaf axils of current season auxiliary shoots. These shoots generally have a base diameter of <0.5 cm. These shoots were most likely produced over the previous spring and summer and will therefore be a maximum of 12 months old by spring when anthesis is expected to occur. The buds are mainly in the distal leaf axils. At this stage, the development of flower buds is unrelated to treatment with growth retardant. Monthly measurements of trunk diameter, tree height and shoot extension have been recorded.

Growth retardant: The oldest Red Bayberry trees on Maroochy Research Station have demonstrated a high level of vigour since planting in mid September, 2005. The most vigorous individual trees are now 4 m tall. There was a concern that this high level of vegetative growth might extend the juvenility phase. The anti-gibberellin, paclobutrazol (Cultar®), was therefore applied to approx. half of the 20 mth old trees in an effort to inhibit vegetative growth and encourage flowering. The standard rate as used in stonefruit (7.5 mL/tree) was applied in late March as a collar drench in 1L of water. Treated trees have been matched with untreated trees of a similar vigour to allow comparison between treated and untreated.

Pest and disease: The only pest of any significance to date has been a tortricidae leaf roller (Patypeplus aprobola). The caterpillar feeds on the shoot terminal leaves and in a minority of cases causes a loss of apical dominance. Damage has not been significant at this stage but this pest has the potential to interfere with tree training strategies if left uncontrolled. Control has been achieved with sprays of spinosad (Success®) approx every 2 months. Small infestations of Nigra scale and Soft brown scale have also occurred. These have been controlled with 3 fortnightly sprays of 1% Bio-pest Oil. No diseases have been observed.”

A3.2. Observations in late 2007 for Red Bayberry at MRS:

“The study trip to China indicated the seedlings planted at Maroochy Research Station are most likely seedlings of Biqi, the most popular variety in China. Anthesis commenced on the trees planted at MRS on 21 Aug. These trees had been field planted for 2 years at that time. Flowering continued over a protracted period until late September. Ten of the 12 seedlings flowered with 5 males and 5 females. Because the trees are wind pollinated and the trees were planted in a single line, hand pollination was done to ensure adequate opportunities for pollination. This may not have been necessary as fruit set occurred heavily on some trees extending into parts of the canopy that were not hand pollinated. Fruit drop commenced on 15 Sept and peaked in early November just before harvest. Over 99% of the shed fruit lacked a developed embryo and was considered un-pollinated. There were large differences between trees in the fruit load. Harvest commenced in the first week of November giving a short fruit development period (approx. 8 weeks). Fruit matured over an approx. 2 week period. There was an approx. 2 week difference in time to harvest between some trees. Terminal growth was suppressed on fruiting terminals and did not commence until early November when fruit started to ripen. There were large differences apparent between trees in fruit quality. The most noticeable differences were in fruit colour, size and flavour. The flavour attributes that varied the
most were acidity and unpleasant resin taste. Chinese bayberry will crop very heavily in SE Qld. The seedlings held at MRS are segregating for tree form, sex, cropping capacity, fruit colour, and fruit flavour, most noticeably acidity and resin taste. Pollination appears to be very efficient. The ability of trees to set heavy crops and carry unpollinated fruit until almost harvest is, however, a problem as there does not appear to be a strategic window for fruit fruiting. The trees respond to growth retardant opening possibilities for growth management.”

A3.3. Observations in 2008-09 for Red Bayberry at MRS:

“Some observations on the older Bayberry trees on Maroochy Research Station are reported here. A small amount of new growth was produced on these trees during spring, 2008, the first since treatment with paclobutrazol in March, 2007. By January, 2009 most of the paclobutrazol treated trees had produced new growth on most terminals and are now showing few obvious symptoms of the growth retardant. Flowering in 2008 appeared to be produced mainly from new buds produced in autumn. Buds produced in December, 2007 did not appear to set fruit. These early buds did not appear to produce healthy flowers. Flowering commenced around 11 Aug, 2008, was strong and generally uninterrupted by rain. Fruit set was heavy in most trees that had cropped the previous year. Some trees that had not cropped previously produced a small quantity of fruit. Because of the excessive fruit set, fruit were small and tightly clustered. Fruit drop commenced on 6 Oct but was most intense around 15 Oct. Harvest commenced on N1MR6 and N1MR9 on 12 Nov. Harvest data is shown in Table A1. Fruit number was calculated by weighing a sample of 100 fruit from most harvests and applying the mean fruit weight to the harvest for that date. The fruit diameter and fruit weight relationship was calculated using fruit diameter and fruit weight data collected on a random sample of 20 fruit from each of trees MR2, MR5 and MR6. These 3 trees covered the size range of fruit produced at MRS. The equation of best fit is an exponential growth equation:

\[ \text{Fruit wt (g) = a.e}^{b \times \text{fruit diameter (mm)}} \]

where \(a = 3.776e^{-1}\) and \(b = 1.270e^{-1}\)

The relationship between fruit weight and fruit diameter is shown in Figure A4.1.

Table A3.1. Fruit number and yield for 4 bayberry trees.

<table>
<thead>
<tr>
<th>Tree</th>
<th>Approx fruit number</th>
<th>Yield (kg)</th>
<th>Mean fruit wt (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>N1MR2</td>
<td>8,055</td>
<td>28.3</td>
<td>3.5</td>
</tr>
<tr>
<td>N1MR6</td>
<td>9,495</td>
<td>41.3</td>
<td>4.3</td>
</tr>
<tr>
<td>N1MR7</td>
<td>8,556</td>
<td>44.9</td>
<td>5.2</td>
</tr>
<tr>
<td>N1MR9</td>
<td>7,349</td>
<td>36.0</td>
<td>4.9</td>
</tr>
</tbody>
</table>
Figure A3.1. Relationship between fruit diameter (mm) and fruit weight (g).

N1MR2 produced small, pale fruit which matured later than other trees (Figure A4.2). N1MR7 produced a reasonable yield of fruit for the first time. Fruit were a good size, dark and with good flavour. Fruit shape was however slightly irregular as it was in 2007. N1MR9 produced a good yield of bright red fruit. N1MR6 produced a good yield of dark red fruit. The resinous flavour which was strong in fruit last year, was less obvious this year. N1MR5 produces a very small quantity of large, dark fruit but data was not collected. N1MR6 and N1MR9 were both of reasonable quality. N1MR6 was slightly superior due to its higher yield and darker colour. N1MR1 was the best of the male trees. It flowers well and has a compact shape with moderate vigour. Pollen grains appear regular but viability has not been checked.

Additional Observations: Both Honey bees and Native bees (Trigona sp) will collect pollen from male trees but have not been observed visiting female trees. Tree harvesting of fruit is possible but stems can occasionally remain on fruit and would need to be removed before packaging. Fruit can be a little sticky to handle due to the production of resin. Birds will feed on fruit close to harvest and trees will therefore need to be netted. Fruit set can be excessive with a substantial decline in fruit size. A low ratio of pollinator trees might minimise this potential problem.”
A3.4. Observations in 2009-10 for Red Bayberry at MRS:

“Flavour of most of the older seedlings improved from last year with less of the unpleasant resinous component. N1MR9 appears the most prolific of the older trees with good yields (34 kg) and acceptable fruit quality. N1MR9 appears the variety with the most commercial potential at this stage. Cropping behaviour of the trees from last year to this year indicates biennial bearing is possible where crops are not thinned adequately.

Flowering was observed for the first time in some of the 141 younger seedlings. These trees were planted in September 2006 and treated with paclobutrazol in April, 2009. Fifty-nine trees flowered in 2009. Twenty-nine of these are males and 30 are females. A diversity of fruit characteristics were represented. Fruit size and fruit number varied considerably between trees. Fruit colour and flavour also varied. Two-3 superior types will be selected for further multiplication.

A substantial quantity of seed were collected from N1MR12 for the production of rootstocks. A small trial examining the effect of a range of seed treatments on germination was established.”

A3.5. Observations and summary in 2010 for Red Bayberry at MRS:

“Older trees (N1 series): Yields in 2009 for trees of interesting selections are shown below (Table A3.2). All trees produced less fruit than in 2008 (particularly N1MR6), displaying substantial biennial bearing. NMR9 performed the best with good yield, fruit colour and flavour. N1MR9 is the most promising variety among these older trees.

Young Trees (N2 series): The young trees were field planted in September, 2006. They were treated with a bark paint of 2 mL Cultar ® in 5 mL NuFilm on 20/4/09. These trees are close planted within a
stone fruit orchard in 2 rows on a single bed with a North-South orientation. The trees were numbered as: (North-East End) 1→71; 72 → 141. Sixty-seven of these trees flowered for the first time in 2009. Fifty-seven % of those that flowered were female. Seventy-four trees (52 % of all young trees) did not flower.

Table A3.2. Yields of three older Red Bayberry trees in 2009.

<table>
<thead>
<tr>
<th>Tree</th>
<th>Yield (kg)</th>
<th>No. fruit</th>
<th>Mean fruit wt (g/fruit)</th>
</tr>
</thead>
<tbody>
<tr>
<td>N1MR6</td>
<td>13.4</td>
<td>2,784</td>
<td>4.8</td>
</tr>
<tr>
<td>N1MR7</td>
<td>8.4</td>
<td>1,680</td>
<td>5.0</td>
</tr>
<tr>
<td>N1MR9</td>
<td>43.3</td>
<td>5,915</td>
<td>7.3</td>
</tr>
</tbody>
</table>

Based on fruit size, yield and flavour, five female trees were identified as worth multiplication for further assessment: Tree 9 produced a moderate yield of large, red-dark red fruit with a slightly agreeable flavour and slightly lumpy appearance. Flavour was very slightly resinous. Tree 9 fruited from 30 Oct – 30 Nov with the main harvest around 12 – 16 Nov. Tree 9 is mid-season. Tree 24 produced a high yield of large, red-dark fruit with a slightly agreeable flavour. Acidity was low and resin flavour minimal. Tree 24 fruited from 30 Oct – 23 Nov with the main harvest around 9 – 12 Nov. Tree 24 is mid-season. Tree 29 produced a high yield of large, dark red fruit with a slightly agreeable flavour. Flavour was low in acidity but with a very slight resinous aftertaste. Tree 29 fruited from 2 – 23 Nov with the main harvest around 9 – 12 Nov. Tree 29 is mid-season. Tree 34 produced the highest yield. Fruit were red and of moderate size with a slightly agreeable flavour. The flavour was low in acidity but slightly resinous. Tree 34 fruited from 12 Nov – 3 Dec with the main harvest around 23 – 30 Nov. Tree 34 was the latest of those selected. Tree 99 produced a moderate yield of small-medium size, dark red fruit with moderately good flavour. The fruit had a low acidity to taste with very little noticeable resin. Tree 99 fruited from 22 Oct – 25 Nov with the main harvest around 27 Oct – 2 Nov. Tree 99 was the earliest of those selected. The very slight resinous aftertaste in some of the selections is expected to decline as the trees mature. Tree 1 produced small, poor quality fruit with a very early maturity.

Male trees were numbers: 8, 19, 20, 21, 25, 33, 38, 39, 40, 42, 44, 46, 48, 49, 57, 58, 70, 72, 86, 88, 95, 102, 103, 109, 115, 126, 127, 129, 138 and 141. Tree 86 exhibited strong flowering and was considered the best of the males. Other males with good early flowering were trees 8, 39, 72, 103 and 115. Tree 8 produced noticeable anthocyanin in the flowers. Tree 20 flowered late.

An as yet unidentified disorder (see six images below) appeared on two of the younger trees during 2009. The disorder appears as a canker in branch angles and lenticels. Young leaves exhibit a reddish motting. Older leaves are shed and small twigs die. The affected tree produces increased suckering. Attempts were made to ascertain if it is pathological in origin. Samples were forwarded to two DEEDI plant pathologists and no bacteria or fungi were isolated. Samples were also forwarded to a DEEDI virologist for Tomato Spotted Wilt virus tests. An ELISA test and inoculators-plant test for TSWV were negative and no virus particles were observed under the electron microscope. Tests for other viruses will continue.
A3.3. Disorder symptoms on stems and leaves of a young Red Bayberry tree.

A3.6. General climate and edaphic characteristics at Maroochy Research Station:

Excerpt from DEEDI (QPIF) documentation regarding climate – “Maroochy Research Station is located at 26°38’40"S., 152°56’23" E. AMG (Australian Map Grid reference) at elevation 32.5 m. GPS coordinates are 7052794 Northing; 493975 Easting. The area has a wet subtropical climate with an annual rainfall between 1300 and 2000 mm. Sixty to seventy percent of rain falls in the summer months of December to March. Occasionally tropical cyclones bring torrential rain and gale-force winds. The average temperature range is 13.6 to 25.6°C. Frosts can occur in low-lying areas in the winter months from mid-June to August. Weather data was recorded manually from a site adjacent to the office buildings until 2007. The Bureau of Meterology website for this info is below. http://www.bom.gov.au/climate/averages/tables/cw_040282.shtml. From 2007 an automatic weather station was commissioned higher up the slope. The BOM website for this data is below. http://www.bom.gov.au/climate/dwo/IDCJDW4091.latest.shtml.”
Information regarding plantings – “The initial planting of 12 Red Bayberry trees was at 4 m apart along the row, with mango trees 6 m away on one side only (i.e. row spacing of 6 m). The soil was an Earthy Podzolic with a Northcote PPF of Wa 18. Sprinkler output (1 per tree) was approx. 35 L/hr and trees were watered once per week for 4-6 hrs during dry periods. They were not irrigated in months of sufficient rainfall. Trees received very little fertiliser as they were vigorous. Approx 300 g Rustica was applied to each tree on 16 Feb, 2010.”
Appendix 4. Summary general guidelines for Red Bayberry cultivation (by Dr Garth Sanewski).

“Red Bayberry (Myrica rubra)

Red or Chinese Bayberry produces bright to dark red/purple berry-like fruit of 20-25 mm diameter with a characteristic papillated skin texture. The fruit is moderately sweet, slightly acid and with a mulberry-like flavour. The juicy flesh clings to the single, hard, 10 mm wide seed.

Varieties: The main Chinese variety BiQi (pronounced BeeChee) is not available outside of China. Selection within a small seedling population in Australia has produced two female varieties for testing. Selections worth trialling are N1MR6 and N1MR9. The male selection N1MR1 appears to flower well and is of a reasonably compact growth habit. Additional female varieties should become available as selection work is completed.

Growth: Trees are vigorous reaching approx 4 m in height after 3 years of field growth. Young, non-cropping trees produce 2-3 growth flushes per year each of approx. 30 cm. Cropping trees produce a maximum of approx. 10cm growth on non-bearing terminals. Bearing shoots produce little growth until after harvest. Shoot growth commences in mid August in coastal SE Qld and is complete by late April. The tree is evergreen, but older leaves are progressively shed during the growing season. If left unpruned, the cropping tree will gradually develop a skirt of branches touching the ground and an open, spreading habit.

Flowering: Fruiting can be expected to occur 2-3 years from planting in a sub-tropical environment with a cool, mild winter. Small buds appear in the distal leaf axils in summer to autumn on weaker current season’s shoots. These shoots generally have a base diameter of <0.5 cm and were produced over the previous spring and summer. Vigorous, upright shoots usually do not produce flowers. Flowering is protracted, occurring from mid August to early October.

Pollination: Chinese Bayberry are wind-pollinated with male and female flowers borne on different trees. Pollination is required for complete fruit development. Male pollinator trees are, therefore, needed within the orchard. However, pollination appears very efficient and only a low ratio of male trees should be necessary. It is recommended to initially plant the orchard with 5% male trees and reduce this as experience indicates.
Male flowers.

Fruit Growth: Fruit set occurs over an extended period due to the protracted flowering. Significant fruit growth commences around late September. Stone hardening occurs around mid-late September. Early fruit drop occurs from late September through to early November, just as harvesting commences. A large percentage of early fruit drop (75%) will be un-pollinated fruit. Fruit will begin to colour by the third week of October.

Harvest: Harvest commences around early November and continues to late November on any tree. Ripe fruit drops daily over this period. Peak harvest occurs around mid-late November. Ideally fruit should be harvested directly from the tree. Highly coloured fruit that harvests with gentle pressure should be mature. A 2 yr old tree can produce from 5-20 kg of fruit. This should increase to 30-40 kg in year 3.

Marketing: Because the fruit has not been marketed previously in Australia and is relatively unknown outside China, market potential is unknown. Consumer evaluation panels in Australia suggest a potential does exist, although volumes cannot be predicted. Fruit appears suited to packaging in strawberry punnets.

Culture:

Plantation Layout: Intensive training systems and hence close-planted layouts might be suitable, but cannot be recommended at this stage due to the lack of information. Wide-spaced plantings are initially recommended. Moderate vigour trees such as N1MR6 should be approx 4 m high and 3.6 m wide after 3 years of growth in SE Qld on a northerly slope with supplemental irrigation.

Pruning: Pruning strategies have not been devised as yet. Only minimal pruning is suggested at this stage, principally to remove lower limbs to allow mulching and weed control. Additional pruning might also be required to control tree size and architecture and/or to reduce the quantity of fruiting wood. Trees produce fruit towards the terminals of slightly weaker shoots, usually those with a base diameter of around 0.5 cm. Tip pruning of these shoots will remove potential fruiting wood and could reduce yields excessively. It is suggested that these shoots are not tip-pruned. It would be preferable to remove some of these shoots entirely rather than tip-prune if the aim is to reduce the crop load. Pruning in early December should allow time for a subsequent flush, whereas pruning in May to July should minimise immediate new growth.

Production Issues: Fruit from young trees can exhibit an objectionable resinous aftertaste due to the production of resins within the fruit pulp. This characteristic should diminish by the second year of cropping but remains as a slight component of flavour. Overcropping can result in a decline in fruit size and tight clustering of fruit. Excessive fruit set should be avoided by not planting too many pollinators. Where excessive fruit set has occurred or where fruit are clustered tightly, hand removal of some in late September to early October might be necessary. Fruit are fragile, somewhat similar to
strawberries, and will require gentle harvesting and handling systems. Fruit are highly perishable. Crops must be harvested every 1-2 days for 2-3 weeks.”
Appendix 5. Poster on Red Bayberry presented at an Australian Society for Horticultural Science conference.

References


This report is about establishing the commercial production and sales potential of Red Bayberry in Australia. Red bayberry (*Myrica rubra*) is a summer season fruit crop from Zhejiang and other provinces of China. It offers an exciting novel opportunity for Australia. Export market opportunities are possible in the longer term, including counter-season marketing into China.

This report is targeted at potential Red Bayberry growers and marketers in Australia. It follows on from an initial scoping project entitled ‘Red Bayberry – A New and Exciting Crop for Australia’ (RIRDC Publication No 05/081). As such, it represents part of ongoing work intended to provide pre- and postproduction horticulture industry members with sufficient background information and data for confident investment in this new crop.

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