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Quality specifications for Australian wildflowers and revised manual of postharvest treatments for wildflowers

RIRDC Publication No. 10/185



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Innovation for rural Australia



Australian Government

**Rural Industries Research and
Development Corporation**

Quality specifications for Australian wildflowers

**and revised manual of postharvest treatments for
wildflowers**

by Bettina Gollnow, John Faragher, Ross Worrall, Lowan Turton and Daryl Joyce

November 2010

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Foreword

To maintain and build industry reputation and market share, wildflower products from Australian and South African species need to meet buyer expectations. This project has produced quality standards for 32 wildflower products to help improve product quality and consistency in the market. These present 'minimum acceptable' and commercially relevant product specifications, with clear colour photographs of stages of opening, in an attractive A4 6 page brochure format. Each specification includes a product description (covering such attributes as flowers, leaves, stem and stage of opening - domestic/export), as well as postharvest product handling and labelling advice.

These specifications were developed through wide consultation with industry members throughout Australia. They are designed for various users including growers and their workers, florists, domestic wholesalers, exporters and importers. They are available individually (separately from this report), and can be viewed and downloaded or purchased online through our website: www.rirdc.gov.au.

This project has also produced a revised edition of a comprehensive manual to provide growers, wholesalers, exporters and retailers with practical information about recommended postharvest handling and treatment of fresh wildflowers. In this second edition there is new information on flower crops and postharvest methods, plus detailed factsheets for an additional 16 flower and foliage products. The manual, "Postharvest Handling of Australian Flowers from Native Plants and Related Species" (2nd edition) is published separately from this report and will be available from RIRDC at the end of 2010.

This report provides information on the development of the specifications and the manual and their uses. These publications will provide valuable information for growers, sellers and users to enable them to improve flower quality and consistency across the industry. As a result, Australian wildflower growers could increase their market share and reputation for quality flowers.

This project was funded from RIRDC Core Funds, which are provided by the Federal Government, and supported by the former NSW Department of Primary Industries (now part of Industry & Investment NSW). Industry funding was contributed by East Coast Wildflowers and Crooby Cottage Wildflowers.

This report is an addition to RIRDC's diverse range of over 2000 research publications and it forms part of our Wildflower & Native Plants R&D program, which aims to manage investment in research and development by the Australian wildflower and native plants industry and government to build:

- a profitable industry through more efficient production methods
- a strong reputation as a supplier of improved, new and innovative products
- expanded domestic and export market opportunities
- sustainable use of land and water resources.

Most of RIRDC's publications are available for viewing, free downloading or purchasing online at www.rirdc.gov.au. Purchases can also be made by phoning 1300 634 313.

Craig Burns
Managing Director
Rural Industries Research and Development Corporation

About the Authors

Bettina Gollnow has been providing extension support to the commercial NSW cut flower industry as the Industry Development Officer (Floriculture) for Industry & Investment NSW – Primary Industries (I&I NSW, formerly the NSW Department of Primary Industries) since 1992. Because the NSW flower industry is so diverse and fragmented, covering a huge range of crops, geographical areas, and market niches, Bettina has built a strong platform to support to the industry through publications, regular industry events and technical resources.

She recently completed a project for RIRDC to develop the current industry R&D plan and to review the achievements of the previous wildflower and native plants R&D plan.

Dr John Faragher has many years experience in research, development and extension in postharvest handling of flowers, fruit and vegetables. He has worked and published on handling of Australian native, South African and traditional flowers, both in Australia and overseas.

Dr Ross Worrall, is Special Research Horticulturist, I&I NSW. Ross is based at the Gosford Horticultural Research Institute, Narara. Ross has been working on the commercial development of Australian native plants for most of his career. He has also conducted research in the areas of plant physiology, potting mixes, breeding systems, postharvest management and plant propagation.

Lowan Turton is a scientific photographer with I&I NSW.

Daryl Joyce is Professor and Director of the Centre for Native Floriculture at the University of Queensland's Gatton Campus. He has worked for over 20 years in horticulture research, teaching and extension in Australia, the USA and the UK. Daryl's research is mostly concerned with the biology of native Australian plants. He has focused on the postharvest biology and technology of native cut flowers and foliage.

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Many members of the Australian wildflower industry have generously provided product samples for photography and/or shared their technical knowledge.

A. Quality specifications for Australian wildflowers
Edited by Matthew Stevens, ScienceScape Editing, Sydney
Designer: Nicky Parker, Wild Poppy Design, NSW

The project was funded by RIRDC, Industry & Investment NSW (I&I NSW) and the following industry partners: East Coast Wildflowers and Crooby Cottage Wildflowers.

The following people made valuable contributions:
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B. “Postharvest Handling of Australian Flowers from Native Plants and Related Species” (2nd edition)

Edited by Matthew Stevens, ScienceScape Editing, Sydney

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Abbreviations

1-MCP	1-methylcyclopropene, a gaseous anti-ethylene treatment.
AFEC	The Australian Flower Export Council (formerly known as FECA)
AFPGA	The Australian Flora & Protea Growers Association (now replaced by WildFlowers Australia Ltd)
APVMA	The Australian Pesticides and Veterinary Medicines Authority
DEEDI	Queensland Department of Employment, Economic Development and Innovation
FECA	The (former) Flower Export Council of Australia Inc.
I&I NSW	Industry & Investment NSW – Primary Industries
NSW DPI	NSW Department of Primary Industries (now part of Industry & Investment NSW)
PBR	Plant breeders' rights
QDPI	Queensland Department of Primary Industries (now DEEDI)
R&D	Research and development
RH	Relative humidity
RIRDC	Rural Industries Research and Development Corporation

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Executive Summary

What the report is about

This report describes how the project developed a series of easy to use quality specifications for the major wildflower products traded on Australia's domestic and export markets. These provide the 'minimum acceptable' product specifications at market entry, using photos and easy to follow charts.

As an additional component to the project, the manual "Postharvest Handling of Australian Native Flowers and Related Species: A Practical Workbook." by J. Faragher, T. Slater, D. Joyce and V. Williamson (RIRDC 2001) was extensively revised. This report describes the information included in the updated edition (hereafter called 'the postharvest manual') and how the manual has been written to support the specifications.

The quality specifications and manual will be published separately from this report. The manual is titled: "Postharvest Handling of Australian Flowers from Native Plants and Related Species" (2nd edition) by J. Faragher, B. Gollnow and D. Joyce. These publications will be an important tool to help the Australian wildflower industry to present more uniform product of an acceptable quality to local and export markets.

Who is the report targeted at?

This report provides wildflower industry members, including, growers, wholesalers, exporters, retailers (such as florists) and researchers, with information about how the project developed quality specifications and a revised and comprehensive postharvest manual covering fresh Australian native flowers and related species, mainly South African Proteaceae. The wildflower industry is that sector of the Australian flower industry focussed on flowers and foliage native to Australia and South Africa, sometimes also called 'hard flowers'.

This report provides practical information about working effectively with different sectors and members of a diverse industry to gather previously unpublished information about market presentation and postharvest handling of wildflowers, with detailed descriptions of almost fifty products.

Where are the relevant industries located in Australia?

Wildflower and native plant products are primarily cultivated in plantations, located in regional Australia. Growers operate in all states of Australia, with significant production areas in SW Western Australia, South Australia, Victoria, the NSW south coast and north coast regions and SE Queensland. There is a degree of specialisation of product in the various states, depending on climatic zones, markets and history of the industry and reflecting commercialisation of species endemic to a given state.

The total value of the industry was estimated at \$50M (wholesale) in 2005. Reliable statistics are very limited and grower numbers vary considerably, depending on the source. ABS statistics are considered to be unreliable and exclude the smaller players who collectively account for a significant proportion of the industry. Australia wide it is estimated that there are around 400 growers.

Plantation size and grower skills vary considerably. Some producers concentrate on a single product, others grow high value niche products and many crops lend themselves to broad acre production. Specialist wholesalers and exporters who deal in wildflowers operate in most states, but especially in Qld, NSW, Victoria and WA.

The wildflower industry has a strong export focus, and wildflowers account for most of Australia's fresh flower exports. There is scope for further growth, especially if exchange rates return to levels more favourable for Australian producers. Currently around 10% of the domestic flower sales are wildflowers but the industry could readily expand its market share. However, this market is highly segmented and many florists and consumers are unaware of the product range and its versatility.

Background

The reputation of the Australian wildflower industry on domestic and export markets has long been undermined by highly variable product quality and presentation. There have been no comprehensive product standards or QA systems adopted across the industry for the major flowers traded. Comparatively little information about harvesting and handling wildflowers has been published. The main single source of postharvest information on wildflowers has been the first edition of the postharvest manual. It needed to be updated.

Aims/objectives

The project aimed to develop commercially relevant 'minimum acceptable' and commercially relevant product specifications for thirty wildflower products, with an emphasis on photographs to document key points. The researchers added two more products, bringing the total to thirty-two specifications.

In addition, the first edition of the postharvest manual was to be reviewed to provide the industry with up to date practical information and advice about postharvest handling of Australian native flowers and related species. The manual was also to provide detailed information to support the quality specifications. Specific information to be included was advice on flower hydration and labelling guidelines to encourage greater consistency across the Australian industry in these areas.

The specifications and the manual were to provide a common basis for growers, their workers, domestic wholesalers, exports, importers and florists to discuss the wildflower products they trade. The revised manual aimed to educate growers, marketers and sellers about appropriate postharvest methods and encourage them to improve their current methods.

Methods used

This project actively gathered information from a broad range of industry members, including growers, researchers, wholesalers, exporters, and importers. It was promoted to industry members several times to raise awareness and gather industry advice about handling the broad range of wildflower products to be covered by individual specifications. Extension was achieved through conference and seminar presentations and articles in industry magazines and newsletters.

A number of workshops were held to collect information on specific products and postharvest practices and later to review and test draft documents and photo assemblages. Specific information was obtained by interviewing experienced growers, marketers and researchers and by reviewing published literature. Several researchers were invited to write product factsheets for the postharvest manual. This captured information from a number of RIRDC projects completed since 2001.

Extension activities conducted throughout the project have already begun the important task of raising industry awareness of the need for more consistent product presentation to markets. Several growers and marketers have tested the specifications developed and found the information clearly presented and easy to follow.

The specifications needed high quality photos of flower maturity stages and product defects, taken in a consistent manner. Photos were mostly taken specifically for the project, as they were not already available. Flower samples were sourced from farms and markets and photographed under standard

conditions. The researchers travelled to farms in several states and regularly visited the Sydney Flower Market to obtain the necessary flower samples.

The expertise of a technical editor and graphic designer combined the information and photos into a visually striking layout with easy to follow charts describing product attributes, stage of opening at harvest, bunching, harvest and postharvest treatments, as well as packaging. Product handling advice for importers, wholesalers and consumers is also presented.

For the manual review, we gathered information from industry members, including growers, researchers, wholesalers, exporters and importers and reviewed the research literature. Information on postharvest technologies, on specific crops, references, internet sites and contacts for further information have been updated and improved. Improved colour pictures have replaced the previous black-and-white pictures.

Results/key findings

The project captured the knowledge and experience of a large number of wildflower industry members to produce detailed postharvest and handling information for forty-eight wildflower products:

- quality specifications illustrated with clear photographs for thirty-two wildflower products (published individually and separately from the manual), and
- new and detailed factsheets for sixteen flowers and foliage, written by researchers with particular expertise on the products, to the same template as the specifications (included in the manual).

The postharvest manual summarises what is known about postharvest handling of Australian native flowers and their relatives. It is based on reviews of the R&D literature and information collected from the practical experiences of growers, wholesalers, exporters, researchers and other technical experts. This is a practical manual, to be used in the packing shed and workplace, with space for users to add their own information. It can also be used as training tool and to develop quality assurance practices and manuals.

The manual complements the quality specifications for thirty-two major Australian flowers, which should prove extremely valuable, and they should be used together. The specifications have been published separately to the manual, but the internet version of the manual includes links to the specifications, and information about how to obtain printed copies of the specifications is included in the manual.

There is new information on postharvest technologies, the benefits of low temperatures, ethylene sensitivity, anti-ethylene treatments (using 1-MCP as EthylBloc[®]), packaging and agricultural chemicals registered for postharvest use.

We have added specialist technical advice on use of agricultural chemicals and worker safety. Due to concerns about OH&S and pesticide and dangerous goods legislation and regulation, advice in the manual and the specifications only refers to legal options and/or products.

The manual also includes a number of templates growers and marketers can adapt to keep their own records.

The manual is approximately 248 pages in length, with colour illustrations and diagrams and has dedicated space for notes. The major sections are:

- Why are postharvest treatments important?
- Basic postharvest treatments and handling for all cut flowers and foliage

- A general postharvest treatment protocol
- Specific postharvest factsheets providing treatments for 16 individual crops
- Notes on 31 other crops
- Additional information on postharvest treatments and allied issues
- Sample worksheets and checklists
- Sources of further information
- Explanation of terms used

As a result of this project, there is now adequate information available about:

- a broad range of information on postharvest principles and practices to assist growers, marketers, researchers, students and others
- the postharvest behaviour and requirements of forty-eight flower and foliage products that have been researched and worked with intensively, and are the subject of the quality specifications or the product factsheets
- The vase life and behaviour in the vase of many freshly picked flowers
- The ability to cold store or ship flowers for prolonged periods.

Research for the project confirmed that currently Australian wildflowers vary widely in their standard and presentation. Many of the samples photographed to record defects and poor quality product were sourced from stands in the Sydney Flower Market. This highlights the importance of the project to educate different industry members about stages of flower opening, overmaturity, product presentation and good postharvest practices.

The researchers also found that growers use different methods on farm to achieve an acceptable market presentation. Where alternative procedures exist, they are included as options in the specifications or the manual.

Apart from waxflower, anti-ethylene treatments for flowers sensitive to ethylene, such as grevillea, do not seem to be routinely used by growers.

The workshops confirmed that many growers make up their own postharvest solutions or simply use fresh clean water, rather than using commercial postharvest solutions. This may lead to suboptimal results, because commercial solutions may contain additional ingredients that enhance postharvest life, especially of woody stemmed flowers (i.e. many wildflowers). Many growers surveyed combine bleach and citric acid in water to make up a simple postharvest solution. This contrasts with recent research findings that in this combination, the efficacy of the chlorine (the active ingredient in the bleach) as a biocide disappears relatively quickly.

There is an internet version available for viewing and downloading on the RIRDC website: downloads at <http://www.rirdc.gov.au/reports/Index.htm>

Printed copies can be purchased online through our website: purchases at www.rirdc.gov.au or on 02 6271 4100.

Implications for relevant stakeholders – wildflower growers, marketers (wholesalers and exporters), and importers

People in the industry can use the specifications and manual to improve their postharvest quality management. All can now refer to a set of common references and present a more uniform product to the market. This will overcome the current variability which adds extra costs (in terms of time and money) to each shipment and which is eroding industry reputation. This should lead to improved sales and returns.

If the specifications are widely adopted by the industry, growers and buyers will have a clearer understanding of what product of acceptable quality looks like because they can now compare their flowers with the photographs in the specifications. The numbered stages of opening and word descriptions will allow growers and sellers to discuss harvest stages and quality requirements desired by their retail customers and also consumers. By following the recommendations for postharvest management provided in each specification, growers, buyers and end customers can maximize the vase life of their wildflowers.

Growers and marketers can use the specifications and postharvest manual to:

- improve the quality and consistency of forty-eight major wildflower products
- develop or improve their own quality standards
- train their staff
- describe and illustrate their product to their buyers (especially distant domestic and overseas buyers)
- develop their own harvest and postharvest handling methods
- support their own quality assurance system
- recommend postharvest treatments to their buyers
- quickly resolve problems that develop after product has left the farm.

In addition, growers can:

- use the outcomes of this project to develop or improve their own harvest methods
- benefit if competing product from other growers is of a lesser standard
- follow clear guidelines to present acceptable product to the market, if they are new to the industry or marketing a new product
- replace wild harvested product with a better quality cultivated alternative
- become more profitable because labour will be used more efficiently to harvest and process only those flowers of minimum marketable quality.

Marketers will benefit because:

- flowers of the same species/type delivered by different growers will be more consistent
- combined shipments will be more uniform, saving them time and labour
- they can receive feedback from buyers and can correct inconsistencies based on defined specifications supported by photos, liaising with their growers to better meet the market's expectations
- they can provide clear feedback to growers if product reaching them does not meet the specification
- buyers can refer to the defined specifications and photos before shipment and on arrival.

The publications developed by this project will be also be a model for other flowers. They also represent the first stage in developing a national quality management system for the wildflower industry.

Implications for relevant stakeholders – retailers (such as florists)

Retailers such as florists can use the specifications and manual to:

- ensure they purchase, and are supplied with, wildflowers at the optimum maturity stage
- make sure they present wildflowers to their customers at the optimum maturity stage
- describe and illustrate wildflower products to their customers

- optimize postharvest handling and solutions
- quickly resolve any problems that develop after sale.

Implications for relevant stakeholders – researchers and students

There is a need for ongoing extension of this information and for ongoing research and development in this area.

For students, the manual and specifications will be an extremely valuable resource.

However, it will be hard, if not impossible, to produce similar publications for wildflowers in future because expertise is rapidly being lost, both to retirement of experts and to experts working for industries where there is adequate funding.

Recommendations

The availability of this manual and the specifications needs to be made widely known, by RIRDC, the authors, industry leaders and bodies and government bodies.

We recommend that industry members adopt the postharvest and quality management practices outlined in the manual and specifications. Individual users can add new information to their manuals and specifications.

The manual can be updated in future, if there is enough new information, demand, funding and expertise to do it.

Recommendations for growers:

- review current product presentation against the relevant specification, and discuss differences with buyers. If changes are needed to bring presentation up to the minimum described in the specification, then adopt the specifications
- review current postharvest practices and do comparative trials against those recommended in the specifications. Adopt improved postharvest methods if necessary
- train farm staff to improve product harvesting, processing and handling using the specifications
- refer to specifications and the manual to resolve any problems
- as an industry, address the practical issues and consequences surrounding registration and regulation of using agricultural chemicals and postharvest disinfestations.

Recommendations for marketers:

- review current product presentation against the relevant specification, and discuss differences with growers. If changes are needed to bring presentation up to the minimum described in the specification, then adopt the specifications and ask growers to supply product as described in the specifications
- review current postharvest practices and compare them with those recommended in the specifications. Adopt improved postharvest methods if necessary
- train staff to improve product processing and handling using the specifications

- discuss product out turn with buyers
- avoid marketing product that is overmature or below the standard described in the specification.

Recommendations for retailers, e.g. florists:

- review current postharvest practices and compare them with those recommended in the specifications. Adopt improved postharvest methods if necessary, e.g. provide customers with sachets of flower food and care instructions
- train staff to improve product handling and postharvest care using the specifications and manual
- discuss product quality and care with consumers
- avoid selling product that is overmature or below the standard described in the specification.

Recommendations for researchers and extension professionals:

Work more closely with growers, exporters, wholesalers, importers and retailers to devise and implement good, practical postharvest treatments.

Develop research projects to fill the current gaps in postharvest knowledge:

- the detailed postharvest biology of many flowers, including ethylene sensitivity, abscission (flower and petal drop) and the importance of *Botrytis* (grey mould) and other fungi
- practical postharvest treatments for export, to ensure that flowers survive export well
- how a range of flowers respond to ethylene and anti-ethylene treatments including the recently available and environmentally friendly 1-MCP
- varietal differences in postharvest life, e.g. in *Chamelaucium*
- the practical issues and consequences surrounding registration and regulation of using agricultural chemicals and postharvest disinfestations
- organise the relevant photographs to convert the factsheets for 16 products to full quality specifications.

Recommendations for teachers and students:

- use the specifications and the manual as extension and training tools
- use them to develop quality assurance practices and manuals and as student texts.

1. Introduction

Reports on the Australian and international floriculture industry have long noted the lack of effective quality standards for wildflower products from Australian and South African species. Industry reviews and assessments of strategies to improve market access have repeatedly highlighted the need to lift the quality and consistency of flowers delivered to market, especially overseas markets (e.g. Karingal Consultants 1997, Gollnow 2002, Salvin et al. 2004, Ridge Partners 2005, Joyce 2005, Ekman 2006). Furthermore, these authors have identified the threat of diminished market presence due to failure to meet market expectations.

Japanese flower importer Mr Nobu Kaishita, Toa Trading, Japan (Gollnow 2006), specifically complained about flowers and leaves dropping off, mixed grades within the same box, inconsistent stem numbers in bunches and 'no confidence to purchase without checking the quality first'.

Reid (2006) and Richardson (2006) have noted that consumer confidence in buying fresh flowers is strongly related to their perceived value - their quality and vase life must be high and consistent over time for consumers to buy again. In recent years, international flower trading and marketing in many European markets has set the bar very high for flower quality and vase life. The UK supermarket chain Tesco gives a 7 day vase life guarantee. Behind this is a series of strict criteria that their suppliers have to meet, designed to guarantee flower quality through combining quality flowers with the optimised logistics, long term planning and effective marketing (van Kooten 2007).

Overseas suppliers are under pressure to comply with strict product specifications, to ensure flowers of the same quality can be marketed all the time. To achieve this, traditional flower producers wishing to secure and maintain their markets, especially in Europe, have developed their own strict and detailed quality procedures. Flores Funza Farms in Colombia provides an example of a large scale flower producer which has based its reputation on the quality of its product (Pizano 2010). An intense focus on postharvest care ensures flowers are cut and graded in an hour or less. All processes such as hydration treatments, cleaning of containers, cold chain management are optimised, monitored and independently audited.

While there are various standards for widely traded flower crops, these have been developed for overseas markets, are often very basic and rarely include wildflowers. An example is the 'Cutflower Minimum Guidelines and Standards' recently published by the Association of Floral Importers of Florida (undated), which includes kangaroo paw as the only wildflower product. The Florida standards are very basic, with a single series of very small images depicting stages of opening and little additional information (such as a written description of what the flower photo shows) to assist the grower or marketer.

For wildflowers, Standards Australia published a series of standards for just 6 products in 2004, but these were very general, included few photos and were not adopted across the industry. They were not commercially relevant by the time they were published (their development took almost 10 years, during which time there were major changes in the flower industry and in the field of quality management). Other published standards are either not current or specific to a particular marketing group, and focussed on a limited number of products (e.g. Chrysal undated). Others are very general, for example covering all South African Proteaceae (e.g. FECA 1992, 1997; AFPGA 1996, 1998, 2000; Bottomley and Smee 1992; TCTV undated; Criley 2007). Most lack clear photographs to assist the user.

Simple and user friendly reference guides to improve the quality and consistency of wildflower products commonly grown in Australia have been missing.

Developments in digital photography, the researchers' industry contacts and extension expertise and the considerable experience of growers, marketers and researchers have been combined to create a significant set of new specifications and product factsheets. These will be available to growers and buyers to use in their market negotiations.

Correct postharvest treatment and handling is essential to maintain cut flower quality during marketing, including exporting. There are many aspects of postharvest handling, from harvesting, cooling, anti-ethylene treatments, postharvest solutions, pest and disease control and packaging to the numerous steps in the marketing chain once flowers leave the grower for the wholesaler or exporter, retailer and eventually the consumer. Postharvest treatments need to be quick, simple, inexpensive but effective.

Relatively few reference and practical books and reviews on postharvest handling of cut flowers are available. These are mostly for traditional flowers (e.g. Nowak and Rudnicki 1990 and Jones 2001). Until the publication of the first edition of the manual *Postharvest Handling of Australian Flowers - from Native Plants and Related Species*" (Faragher et al) in 2002, the information on Australian native flowers and related species was widely dispersed. There is also a huge amount of practical knowledge in the minds and notes of growers, wholesalers and exporters which has never been published.

Some of the most valuable sources of recorded information identified in 2001 remain important today. However relatively few of these have been updated with new knowledge and some are no longer published.

We set out to update the information compiled in the first edition into a practical manual that will provide growers with comprehensive information, advice and recommendations. Information on technical issues in the manual and specifications needed to be consistent. The manual provides extensive and relevant additional details to assist growers, wholesalers, retailers and educators in their understanding of the specific postharvest treatments that will optimise vase life of wildflowers.

The important outcomes of this project, the thirty-two quality specifications and the revised postharvest manual, are published separately. Therefore this report is only a brief summary of what was done, what is in the specifications and the manual, the conclusions we've drawn from the project and our recommendations.



Figure 1. Florists enjoy working creatively with Australian wildflower products.

2. Objectives

The objectives of this project were to:

- develop commercially relevant 'minimum acceptable' and commercially relevant product specifications, including photographic standards, for thirty wildflower products, including description (covering such attributes as flowers, leaves, stem and stage of opening - domestic/export), photos, product handling and labelling protocols.
- develop a checklist for assessing product quality at market entry point (wholesaler/exporter).
- provide feedback to participating growers and marketers.
- promote the project concept and resulting product specifications widely to industry as tools to be used to raise standards, and make these tools readily available.
- review and update the 2002 wildflower post harvest manual (RIRDC Project DAV-175A, RIRDC Publication No.02/021) - approved as a variation to the quality specifications project in June 2008 with additional funding.

This project aimed to address Objective Two of the current Wildflowers and Native Plants R&D Plan (2008-2013): i.e to improve product quality through postharvest care and quality standards.

3. Methodology

Products selected for specifications

Consultation with exporters, wholesalers and growers developed a short list of potential flowers where specifications would assist both growers and marketers. Six exporters (based in Queensland, NSW and Victoria) and three wholesalers were interviewed.

This was followed by a national industry survey, designed to identify up to thirty products currently adversely affected in the marketplace by variable quality and presentation. This was circulated in August 2007 by email either directly or via existing industry networks, and assorted feedback was received (see Table 1).

Table 1. Participants in national industry survey.

Industry member category	No. of replies (survey or personal interview)	No. responding and willing to participate in project
grower	7	1 (Vic), 6 (NSW)
exporter	2	1 (Vic)
domestic marketer	1	1 (NSW)
researcher/extension specialist	2	1 (Qld)
consultant	1	0
total	13	10

From these suggestions, a ‘short list’ of potential products was prepared and circulated via email to a broader range of stateholders throughout Australia (using industry networks like WildFlowers Australia Ltd and WA Floriculture Newsletter produced by the WA Department of Agriculture and Food). This generated another eleven replies.

Table 2 gives the product list derived from approximately twenty-five stakeholders’ comments. Many products were only identified by one person, which made it difficult to choose which ones to include and which ones to leave out. Several people nominated only the broad category, e.g. ‘kangaroo paws’ or ‘eucalypts’ without mentioning specific forms, product types or cultivars. Six stakeholders confirmed the importance of including the products already short listed. It was decided not to include foliage products, as these generally return a lesser value per bunch than focal or filler products.

Table 2. Products nominated for inclusion in the project (for which quality specifications would benefit the Australian industry).

Product in alphabetical order by botanical name (common name if required)	No. of votes recorded for this product in industry survey
<i>Actinotis</i> (Flannel flower)	5
<i>Anigozanthos</i> as a category (kangaroo paws)	6
<i>Banksia</i> as a category	8
<i>Berzelia</i>	2
<i>Blandfordia</i> (Christmas bells)	3
<i>Boronia</i> as a category	3
<i>Ceratopetalum</i> (Christmas bush)	5
<i>Chamelaucium</i> (waxflower) as a category	7
<i>Eucalyptus</i> as a category (many did not specify which product – flowers, foliage etc)	3
<i>Grevillea</i> as a category	3
<i>Leptospermum</i> as a category	3
<i>Leucadendron</i> as a category	8
<i>Leucospermum</i> as a category	7
<i>Ozothamnus</i> (riceflower) as a category	5
<i>Protea</i> as a category	7
<i>Serruria florida</i>	5
<i>Telopea speciosissima</i> (waratah)	3
<i>Thryptomene</i> as a category	5

Products short listed for specifications had to meet the following criteria:

- their marketability would be improved by greater uniformity in quality and presentation (e.g. flannel flower, WA Banksias, Christmas bush, Leucodendron, Leucospermum, Proteas, kangaroo paw and Macropidia), or
- they were relatively new products where larger volumes of product will soon come into production and there is an opportunity to 'get it right' early (*Banksia plagiocarpa*, terminal grevilleas, flowering eucalyptus for domestic sales)
- they were cultivated products, not wild harvested
- they were preferably marketed on both domestic and export markets
- they were being grown in reasonable quantities by a reasonable number of growers
- where a number of species and/or cultivars are grown, a nominated species or variety could be chosen as the example for the specification.

By May 2008, thirty products had been listed and confirmed following consultation with members of the RIRDC wildflowers and native plants advisory committee. Some adjustments were made to the product list when it became clear that some products were less commonly traded than at first thought (e.g. *Protea* 'Grandicolor'^{PBR} replaced *Protea lacticolor*) and other cultivars were substituted due to the need to liaise closely with a known grower (*L.* 'Veldt Fire' replaced by *L.* 'Tango'). *Banksia hookeriana* and *Banksia menziesii* replaced *Eriostemon australasius* and *Geleznovia verrucosa*, as the Banksias are cultivated and traded in greater volumes. *Eriostemon* and *Geleznovia* each received a detailed postharvest fact sheet in the revised postharvest manual. The researchers added *Blandfordia* and *Doryanthes*, bringing the total number of specifications to 32.

Existing product standards or specifications were identified and reviewed.



Figure 2. Wildflowers are traded in many Australian domestic markets, alongside traditional flowers. However, they have some unique features requiring specific postharvest management.

Format of specifications

Flower specifications were developed to describe the stem (length, thickness and straightness), foliage (colour and freedom from blemish), flowers (e.g. colour, and freedom from blemish and defects) and stages of opening. A 'minimum acceptable' grade was described, and if the product is bunched, guidelines for bunches were included. An introduction to the product was written, outlining its common and botanical names, describing the flower or flowerhead and foliage, origins in cultivation, specific production issues, season of availability and typical vase life. This introduction aims to increase grower and buyer knowledge of each product and build greater appreciation in the market of the challenges of supplying a quality flower to the market.

Drafts were written following a simple template and a graphic designer prepared concept layouts for three of the products (Christmas bush, flannel flower and waratahs). These were used to gain industry interest and involvement, including from Japanese buyers.

This template was extensively improved by the technical editor who set a clearer style and format. This followed the path of the product from harvest through the packing shed and on to despatch to the customer. Common postharvest problems and how to address them were included. Drafts were checked by postharvest experts Dr John Faragher and Professor Daryl Joyce, other researchers, growers and marketers.

Image sets were prepared to a standardised format and included:

- an image of the product on the cover of the specification
- bunches (with and without sleeves, where appropriate)
- a series of product images ranging from 'too immature to market' to 'overmature'. For some flowers, like proteas, the flowerheads are shown from the side and from the top. For others, like waxflower and *Leptospermum*, a series of individual flowers from bud to overmature is provided. For some products, such as *Scholtzia*, stages of opening include both a whole flowering stem and a close up view of a twig
- up to twelve defects to be avoided at market entry.

Finally a graphic designer combined the image sets and captions and edited text and tables for each product to produce the final specification. This is in the form of a three sheet (six page) A4 brochure which celebrates the beauty of each flower as well as providing the required information in a clear format. The brochure design was checked and colours and image backgrounds corrected to make them uniform.

An initial print run is being funded by the project to ensure that colour reproduction of the printed brochures is of high quality and 'true to life'. This is in recognition that specifications downloaded from the web will vary in colour reproduction due to variations in computer screens and printers. The specifications link the reader to more detailed information provided in the postharvest manual, such as anti-ethylene treatments and postharvest disinfection.

Project extension

There was a strong extension focus throughout the project. Articles were published in industry newsletters and magazines at the start and during the project (see Results). Recognising that effective communication with the very fragmented and geographically dispersed Australian wildflower industry is challenging, multiple channels of communication were used.

Presentations on the project were made at several industry meetings and conferences between 2007 and 2010.

The three concept specifications were taken to IFEX Japan by RIRDC industry advisory committee member, Lodi Pameijer (October 2009).

Industry consultation and workshops

At the start of the project, a trial was conducted with waratah growers through the Waratah Industry Network. Twelve waratah growers were sent the draft specification and stem angle chart to test during the 2007 season. Waratahs were assessed in the Sydney Flower Market at the peak of the season, and blooms from growers aware of the specifications were generally more consistently graded and presented, and of a better quality. This approach was refined for the other specifications.

Industry advice was sought throughout the project to define harvesting and handling methods used and identify quality issues with particular products. In many cases, different growers handled their product differently but achieved quality output and satisfied buyers. Draft specifications and image sets were developed with industry members (growers, marketers and researchers in NSW, Qld, SA and WA), experienced in the particular product, either face to face or via email or telephone interviews. This ensured that the information is commercially relevant and at the same time increased awareness of the project.

There were also regular discussions with staff of Sydney wholesaler East Coast Wildflowers about product received from growers around Australia. Other wholesalers were also consulted about the project.

In addition, workshops were used to encourage debate among industry members experienced in the various products and to build understanding of the specifications and how they can be used.

The final draft of the Christmas Bush specification was provided to mid north coast growers for a pre-season workshop in October 2009, while waratah growers reviewed the final design for the waratah specification in February 2010. Very positive feedback was received for both.

The researchers travelled to the following growing regions to access plantations for product samples and discuss details of harvest and postharvest management with growers and researchers:

- NSW mid north coast
- NSW South Coast
- Sydney region
- Southern Highlands, NSW
- Toowoomba (Qld)
- WA (regions north and south of Perth).



Figure 3. The researchers visited many farms to collect product samples for photography. Bettina Gollnow (right) discusses riceflower with NSW grower Alan Kilpatrick.



Figure 4. Grower workshops were used to gather information and build understanding of the specifications and how they can be used.

Product photos

A major goal of the project was to assemble an extensive photo library to record product meeting the 'minimum acceptable' specification covering stages of opening, bunching and also common defects, e.g. damage, grow through and other blemishes.

The researchers reviewed publications and photo libraries by others in Australia but unfortunately few suitable images were available. Most photos needed for the specifications were taken specifically by the researchers, either in a photographic studio or in simulated studio conditions during trips to growing regions.

For each product there are typically twenty to twenty-five different photos within the specification. They were taken against a contrasting and uniform background, usually black. Some flowers were challenging to photograph well and several attempts over two seasons were needed, using different background colours (blue or grey). Such flowers were *Macropidia*, *Banksia plagiocarpa*, *Berzelia*, *Leucadendron* ‘Safari Sunset’ and red kangaroo paw.

Flat uniform lighting, such as that provided by a light tent or multiple flash units was used, rather than side lighting, to eliminate shadows. This was important for bunch photos and multiple stems. Alternatively a single flash unit was used with the black background some distance behind the flowers.



Figure 5. Products were photographed specifically for the project, often in simulated studio conditions on farms. Photo shows Dr Ross Worrall photographing *Macropidia*.



Figure 6: Many growers contributed to the project, some by posting samples for photography to the researchers.

Considerable time was needed to assemble high quality photos of all maturity stages and typical defects. Due to the short flowering season of many of the products, the researchers had to work quickly with growers and marketers to collect enough samples for all photos needed. Samples for photography were sourced from twenty farms in NSW, Qld, SA and WA, and from wholesalers at the Sydney Flower Market. Several growers provided significant support to the project by posting flower samples at varying stages to the researchers so these could be photographed.



Figure 7. Considerable time was needed to assemble high quality photos of all maturity stages and typical defects. These photos show grevillea flowers at 3 different maturity stages, ranging from immature (left), ideal to market (centre) to overmature (right).

Some photos have been provided by industry members, industry photographers and interstate Departments of Agriculture. All photos used in the specifications are lodged in the photo library of I&I NSW.

During the final design stage, it was necessary to digitally adjust some images to provide uniformity of backgrounds. Major changes to colour or image makeup were not undertaken to ensure the integrity of the flower form and appearance.

Representative product images for the thirty-two products have been released to WildFlowers Australia Ltd for posting on their website.

Checklist for assessing flower quality at market entry point

A checklist for assessing flower quality at market entry point (wholesaler/exporter) was developed. This was successfully applied to product samples sourced from the wholesalers at the Sydney Flower Market during the Campbelltown grower workshop (2009).

It proved difficult to apply the checklist at Sydney Flower Market wholesalers, due to the time of day that product arrives and is unpacked and the commercial imperative to put product on the market floor quickly. Instead, the quality of the thirty-two products was assessed at the Market throughout the project. A broad range of quality was observed and recorded through photos.

Box labelling guidelines

Considerable variation in information placed on flower boxes was observed. The project collated information on labelling to provide some useful guidelines for the industry. Around thirty growers and marketers were surveyed about how they pack and label their boxes. Guidelines for labelling are included in the postharvest manual.

Pesticide and OHS issues

Information on agricultural chemicals and postharvest treatments was reviewed by a technical expert to ensure legal and OH&S requirements are met. During the project, a major issue arose in regard to advice on postharvest solutions and their preparation. This was because certain biocide components potentially used by growers (pool chlorine products) are registered as pesticides by the APVMA, but not for cut flower use. A meeting was held with the APVMA to resolve this and registered biocide products which can be recommended identified.

Postharvest manual review

The aim was to update the first edition of this comprehensive manual to provide the practical information growers, exporters and wholesalers want to know about postharvest treatments and handling of fresh Australian native flowers and related species. Correct treatments are essential to maintain cut flower quality during marketing, including exporting. The many critical aspects to postharvest handling were reviewed. This was done largely by the principal author of the first edition, Dr John Faragher. The researchers cross checked information in the manual and specifications to ensure the technical advice is consistent.

The manual itself is published separately. Therefore this report is only a brief summary of what was done. A few aspects of our approach are worth pointing out.

We sought and included advice from growers, exporters, growers' associations, and researchers about what they wanted in this revised edition.

We sought and received information to put into the manual from growers, exporters, associated businesses, government staff and other R&D and extension workers.

Detailed factsheets on sixteen products were written by researchers with expertise in those flowers and foliage. The format of these as the same as that used for the full quality specifications.

To make the manual relevant, interesting, clear and accessible, it was edited by a technical editor. All photos included are in colour and new images and diagrams have been added where necessary. All are lodged in the photo library of I&I NSW.



Figure 8. A new and appealing cover was designed for the postharvest manual.

4. Results

4.1 Quality specifications

The main objective of the project was

- to develop commercially relevant 'minimum acceptable' and commercially relevant product specifications, including photographic standards, for 30 wildflower products, including description (covering such attributes as flowers, leaves, stem and stage of opening - domestic/export), photos, product handling and labelling protocols.

We have produced quality specifications for thirty-two different wildflower products. Full specifications were produced for two additional products (*Blandfordia* and *Doryanthes*) instead of detailed factsheets.

The graphic designer created a very appealing layout for each product, highlighting the particular beauty of the flower and broadening the visual appeal of the information to attract a wider audience, such as florists.

Each product specification includes the following information:

- Page 1 (cover): product photo, botanical name and common name
- Page 2: Product introduction, key quality messages highlighted, flowering season, vase life and other products that specification could cover (e.g. other species or selections)
- Pages 3 and 4: Photos with captions - series of flowers at different opening stages and common defects to be avoided at market entry, along with a list of common defects
- Pages 5 and 6: Product description and handling advice presented as a table (typical template below):

Flowers:

- appearance
- when to harvest
- damage
- contamination
- pests and diseases

Leaves:

- appearance
- when to harvest
- damage

Stems:

- appearance
- at harvest
- length

Recommended handling at harvest:

Grading and bunching details:

- grading
- stem length
- bunching
- sleeves
- stems per bunch

Holding and storage advice:

- cooling
- temperature and humidity
- anti-ethylene treatment (if required)
- postharvest solutions – pulsing solution (if required), postharvest solution, holding solution
- longer term storage advice

Packaging advice

Labelling and documentation advice

Transport conditions

Common postharvest problems and how to avoid or manage them

Handling messages for others in the chain – marketers, retailers (e.g. florists), consumers



Figure 9a. Sample specification for *Leucadendron* 'Safari Sunset' – cover and page 2 giving product introduction.

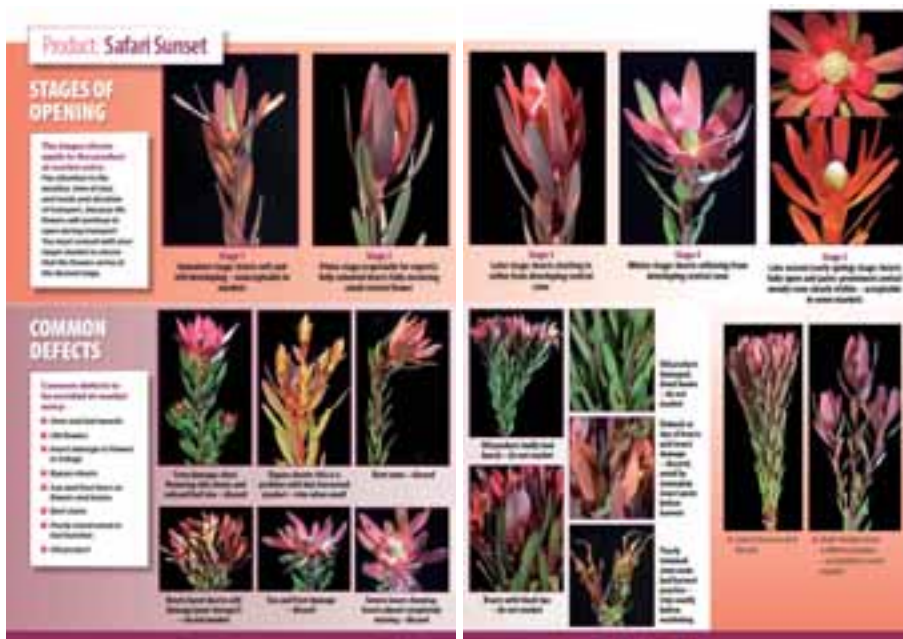


Figure 9b. Sample specification for *Leucadendron* 'Safari Sunset' – pages 3 and 4 showing stages of opening, a typical bunch and common defects to be avoided at market entry.



Figure 9c. Sample specification for *Leucadendron* 'Safari Sunset' – pages 5 and 6 showing charts describing product appearance, plus handling, storage, packaging, labelling and transport advice, details of common postharvest problems and messages for others in the chain – marketers, retailers (e.g. florists), consumers.

The specifications have been designed to be used in several ways. Businesses (growers, wholesalers, exporters and buyers) can:

- use or adapt them for their own quality standards
- use them to train staff
- display them in packing/grading areas
- use them to describe and illustrate their product to their buyers
- use them to agree on quality requirements with buyers
- use them to recommend postharvest treatments to buyers
- use them to resolve problems and complaints
- use them to develop their own harvest and postharvest handling methods
- use them as part of their quality assurance system.

Additional challenges were presented by products that change in appearance at different times of the year and are marketed looking quite different – e.g. *Leucadendron* ‘Safari Sunset’ and ‘Pisa’ and *Thryptomene*. Some, like Christmas bush, have product stages related to colour density, rather than product maturity. Where a wildflower species can yield more than one product, e.g. flowers and fruit (cones or nuts), these other products are mentioned in the specification.

We have provided information on the vase life of the freshly cut product, usually at 20°C, 60 to 70% RH and with twelve hours light per day. However, vase life depends on many factors, so this information is intended as a guide only. Where detailed vase life studies have not been conducted, vase life was estimated by consensus with experienced industry members.

Table 3. Wildflower products for which specifications have been written.

Pub No	Publication title	Botanical name	Web address
10/028	Flannel flower	<i>Actinotus</i> (Flannel flower)	https://rirdc.infoservices.com.au/items10-028
10/029	Kangaroo paw	<i>Anigozanthos</i> ‘Big Red’	https://rirdc.infoservices.com.au/items10-029
10/030	Black kangaroo paw	<i>Macropidia</i> (Black kangaroo paw)	https://rirdc.infoservices.com.au/items10-030
10/031	Baxter’s banksia	<i>Banksia baxteri</i>	https://rirdc.infoservices.com.au/items10-031
10/032	Scarlet banksia	<i>Banksia coccinea</i>	https://rirdc.infoservices.com.au/items10-032
10/033	Hooker’s banksia	<i>Banksia hookeriana</i>	https://rirdc.infoservices.com.au/items10-033
10/034	Menzies’ banksia	<i>Banksia menziesii</i>	https://rirdc.infoservices.com.au/items10-034
10/035	Hinchinbrook banksia	<i>Banksia plagiocarpa</i>	https://rirdc.infoservices.com.au/items10-035
10/036	<i>Berzelia</i>	<i>Berzelia lanuginosa</i>	https://rirdc.infoservices.com.au/items10-036
10/037	Boronia	<i>Boronia</i> ‘Lipstick’	https://rirdc.infoservices.com.au/items10-037
10/038	Christmas bush	<i>Ceratopetalum gummiferum</i> ‘Albery’s Red’	https://rirdc.infoservices.com.au/items10-038
10/039	Waxflower	<i>Chamelaucium</i> ‘Purple Pride’	https://rirdc.infoservices.com.au/items10-039
10/040	Pearlflower	<i>Chamelaucium</i> ‘Bridal Pearl’ ^{db}	https://rirdc.infoservices.com.au/items10-040
10/041	Eucalyptus flowers	<i>Corymbia</i> flowers (<i>ficifolia</i> hybrids)	https://rirdc.infoservices.com.au/items10-041
10/042	Grevillea flowers	<i>Grevillea</i> ‘Moonlight’	https://rirdc.infoservices.com.au/items10-042
10/043	Leptospermum	<i>Leptospermum</i> ‘Lavender Queen’	https://rirdc.infoservices.com.au/items10-043
10/044	<i>Leucadendron</i> ‘Jubilee Crown’	<i>Leucadendron</i> ‘Jubilee Crown’	https://rirdc.infoservices.com.au/items10-044
10/045	Safari Sunset	<i>Leucadendron</i> ‘Safari Sunset’	https://rirdc.infoservices.com.au/items10-045
10/046	<i>Leucadendron</i> ‘Pisa’	<i>Leucadendron</i> ‘Pisa’	https://rirdc.infoservices.com.au/items10-046
10/047	<i>Leucospermum</i> ‘High Gold’	<i>Leucospermum</i> ‘High Gold’	https://rirdc.infoservices.com.au/items10-047
10/048	<i>Leucospermum</i> ‘Tango’	<i>Leucospermum</i> ‘Tango’	https://rirdc.infoservices.com.au/items10-048
10/049	Rice flower	<i>Ozothamnus</i>	https://rirdc.infoservices.com.au/items10-049
10/050	King <i>Protea</i>	<i>Protea cynaroides</i>	https://rirdc.infoservices.com.au/items10-050
10/051	<i>Protea</i> ‘Pink Ice’	<i>Protea</i> ‘Pink Ice’	https://rirdc.infoservices.com.au/items10-051
10/052	Grandicolor	<i>Protea</i> ‘Grandicolor’ ^{db}	https://rirdc.infoservices.com.au/items10-052
10/053	Honey protea	<i>Protea repens</i>	https://rirdc.infoservices.com.au/items10-053
10/054	Blushing bride	<i>Serruria florida</i>	https://rirdc.infoservices.com.au/items10-054
10/055	Scholtzia	<i>Scholtzia involucrata</i>	https://rirdc.infoservices.com.au/items10-055
10/056	Waratah	<i>Telopea speciosissima</i>	https://rirdc.infoservices.com.au/items10-056
10/057	Thryptomene	<i>Thryptomene calycina</i>	https://rirdc.infoservices.com.au/items10-057
10/058	Christmas bells	<i>Blandfordia grandiflora</i>	https://rirdc.infoservices.com.au/items10-058
10/059	Gynea lily	<i>Doryanthes excelsa</i>	https://rirdc.infoservices.com.au/items10-059



Figure 10. The wildflower quality specifications aim to remove poor quality products like this grevillea bunch (left) from the marketplace and ensure buyers receive good quality flowers at the correct maturity stage (right bunch).

4.2 “Postharvest Handling of Australian Flowers from Native Plants and Related Species” (2nd edition)

The project objectives met by this section were:

- to review and update the 2002 wildflower post harvest manual (RIRDC Project DAV-175A, RIRDC Publication No.02/021), and
- to develop a checklist for assessing product quality at market entry point (wholesaler/exporter).

Manual update

The information published in the first edition has been updated and this provides important support to the quality specifications with advice on picking, cooling, grading, hydration, ethylene, leaf blackening, disinfestation, packaging, labeling and exporting. The manual includes simple methods growers can apply to their products, such as how to test for ethylene sensitivity, testing postharvest solution uptake, testing coolroom temperature, and how to test vase life.

It includes a new section giving detailed postharvest information about 16 important crops which can easily be updated to full specifications through the addition of photos.

The manual also provides an updated list of other sources of information, e.g. agricultural chemicals and drying, dyeing and preserving. It includes examples of work sheets and checklists that growers and other industry members can use or adapt to keep their own records. A useful ‘stem angle’ chart has been prepared.

Checklist for assessing market quality

A checklist for assessing product quality at market entry point (wholesaler/exporter) was tested at an industry workshop and is included as Worksheet 9 in the manual. A checklist for growers to use is also included (flower quality checklist, Worksheet 8).

Industry has been given feedback on the variable quality offered to buyers via extension articles and conference presentations. Paired photos have been used to give examples of product sourced from the market floor, one being acceptable and the other not meeting the specification.

Pesticides, postharvest treatments and OHS issues

Only biocides and postharvest treatments legally permitted for cut flowers have been recommended. Hydroxyquinoline citrate and sulphate are often recommended in the literature as biocides because they are very effective. However we have not recommended them because they are not registered and because the Material Safety Data Sheet states: “Laboratory studies have shown 8-hydroxyquinoline to be a possible mutagen” (i.e. it can alter chromosomes).

Similarly due to legal liability, OHS and environmental concerns, only commercially available anti-ethylene treatments are recommended. ‘Do-it-yourself’ recipes have not been included. Some anti-ethylene treatments involve the use of silver which is a heavy metal and dangerous to users and the environment.

Current legal postharvest disinfestation protocols include fumigation with certain products according to their label. Not all commercially available fumigants are legally allowed to be used on flowers and some can only be used by a licensed operator. Alternatively a postharvest dip in an insecticide and

fungicide combination is used for some flowers. In many states, the products used for this purpose must have this use pattern on their label or be allowed through a minor use permit issued by the APVMA. This allows a limited number of chemicals to be used for this application.

Agricultural wetters are also recommended for flowers but current product labels may preclude them from postharvest use on flowers in many states.

Manual contents

The following is a copy of the Table of Contents of the manual.

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Abbreviations

Plant and fungi names used

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 - Smokebush (*Conospermum*)
 - Corynanthera* (Golden cascade)
 - Eriostemon
 - Eucalyptus* foliage
 - Geleznovia* (Yellow Bells)
 - Ixodia*
 - North Queensland rainforest foliages
 - Ptilotus*
 - Qualup bells* (*Pimelia physodes*)
 - Spyridium* (Corroboree flower, Cotton bush)
 - Verticordia*
 - 5.2 Other crops
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 - 8.3 Useful organisations and contacts
- 9. Explanation of terms

Gaps in postharvest research identified

The review of the postharvest literature has confirmed that there is inadequate information available about several specific areas, including:

- practical postharvest treatments to ensure that flowers survive export well. For example, we don't know if treatments with wetting agents, strong citric acid, deep water, or sugar before export will improve water uptake and quality after export
- the detailed postharvest biology of many flowers, including abscission (petal, flower and leaf drop), ethylene sensitivity and the importance of *Botrytis* (grey mould) and *Alternaria* fungi in flowers other than *Chamelaucium*
- practical treatments for many flowers, including hydrating treatments, sugar pulses and anti-ethylene treatments for, e.g. *Banksia*, *Crowea*, *Eriostemon*, *Eucalyptus*, *Leptospermum* (tea tree), *Serruria* and others
- how a wide range of flowers respond to ethylene and anti-ethylene treatments including the environmentally friendly product 1-MCP
- which species, hybrids or varieties of a particular flower have the best postharvest life, particularly after export. For example, different *Chamelaucium* and *Leptospermum* species and varieties have quite different sensitivities to ethylene and thus a different likelihood of dropping flowers and petals.

Reasons why postharvest treatment of wildflowers is currently variable

Regular visits to the Sydney Flower Market during the project highlighted that there are many quality problems specific to wildflowers. Some of the poor quality product observed (such as poorly constructed bunches, overmature flowers, grow through, and poor quality foliage due to pests, diseases or poor nutrition) is the fault of the grower. Some is due to poor handling by the wholesaler or a lack of understanding of the stages of flower development and how these relate to optimum vase life (for example overmature product, dried out product and flower stems with severe leaf blackening). This is partly because wildflowers have some unique attributes not shared by the traditional flowers many sellers are used to handling.

Quality problems specific to wildflowers include:

- some buyers are not as discerning or simply don't understand what poor quality is or that a flower is too open and won't offer maximum vase life
- more wholesalers are handling wildflowers – many poorly. There may be a perception by some that wildflowers 'last longer' – so they not sold quickly and not looked at closely (many don't wilt but gradually dry out)
- woody stems need recutting and take up large volumes of solution, but many wildflowers offered for sale are poorly hydrated
- some growers aim to 'sell everything' they pick
- new growers are unsure of what to do
- some wholesalers like to sell 'seconds' (but don't label them as such) and such flowers do not meet these specifications
- some domestic growers ship their flowers to market in very large but relatively flimsy boxes. By the time they reach the wholesaler, the box is often damaged, with the bottom bulging out

or about to give way because the cardboard got too wet. These heavy boxes are hard for workers to manage and the weight of the flowers inside means those on the bottom may be crushed. Collapsed boxes have to be thrown out and can't be recycled.

A number of these problems require a better understanding of wildflowers, which are botanically different from many flowers people are used to handling. For example:

- many products are complex flower heads composed of hundreds of florets – these may have pin-like styles that get tangled with each other or break off, or they may produce abundant nectar as they open
- many feature colourful bracts rather than petals
- wild harvested product may compete with cultivated product, but buyers don't know the difference
- some products change in appearance at different times of the year and look quite different – e.g. *Leucadendron* 'Safari Sunset' and 'Pisa'
- bypass growth and grow through can spoil product appearance.

This creates the potential for postharvest issues not encountered with other types of flowers. For example as the florets in a complex flower head (seen in *Banksia*, *Protea*, *Leucospermum* and *Grevillea*) develop and open, they draw on food reserves in leaves, they produce nectar (which in turn attracts birds and bees) and the appearance of the flower head changes completely. These attributes need to be managed by the grower and/or the marketer to avoid major postharvest problems that will reduce quality and marketability.



Figure 11. Correct postharvest management requires a good understanding of the unique features of wildflowers. The spectacular king protea is an example of a complex flower head composed of hundreds of individual florets surrounded by attractive bracts.

4.3 Project extension and publications arising from the project

The objectives addressed by extension and publications were:

- to promote the project concept and resulting product specifications widely to industry as tools to be used to raise standards, and make these tools readily available, and
- to provide feedback to participating growers and marketers.

The objective of promoting the project to industry and providing feedback to participating growers and marketers was fully met through involving industry members in workshops and gathering their knowledge of specific products and handling procedures. In addition information on the project was promoted to industry members through several presentations at conferences and seminars and published articles in industry media.

Presentations were made at the following industry meetings and conferences:

- Waratah Industry Network meeting (June 2007)
- Native Flower Growers Association meeting, Mid North Coast (NSW) (August 2007)
- 2008 NSW Wildflower Conference, Sydney (attended by 90 people). It was well received and generated 15 additional expressions of interest from industry collaborators
- 2009 NSW Wildflower Conference, Sydney
- 2009 FAQI Queensland Native and Wildflower Seminar, Toowoomba
- 8th Australian Wildflower Conference (Healesville, May 2010)
- Waratah Industry Network meeting (June 2010).

The following reports on the project were published in industry newsletters and magazines to raise awareness and gain greater industry involvement in the project.

Gollnow B. 2007. Waratah specifications. Waratah Industry Network Newsletter issue 17, 2

Gollnow B. 2007. Wildflower specifications project aims to lift quality. Australian Flower Industry issue No.16, 36-37

Gollnow B. 2007. Native cut flower specifications to lift quality. Floriculture News (WA Department of Agriculture & Food), no. 69, 18-20

Gollnow B. 2008. Specifications project aims to lift wildflower quality. NSW Flower News issue 9, 3-4

Gollnow B. 2008. Photos and new specs will raise standards. Agriculture Today, August 28, 2008, 3

Gollnow B. 2008. Development of commercially relevant production specifications. Australian Flower Industry issue 21, 10-12

Gollnow B. 2009. Workshops fine tune specifications. NSW Flower News issue 11, Autumn 2009, 5-6

Gollnow B. 2010 Wildflower specifications and postharvest manual – RIRDC project update. Australian Flower Industry issue 26 Grower focus, 13

McConchie R, Delaporte K, Ekman J, Gollnow B, Lidbetter J, Srhoj, J, Seaton K and Worrall R 2008. Standing out from the bunch: an Australian update on postharvest care. 13th International Protea Conference, Stellenbosch, Sth Africa, 3-6th September. Acta Hort. (in press)

Workshops were used to encourage debate among industry members experienced in the various products and build understanding of the specifications and how they can be used.

The following workshops were completed:

- Mid north coast, NSW (September 2009): feedback on draft specifications for Christmas bush, flannel flower, kangaroo paw, *Macropidia*, *Banksia plagiocarpa*
- Mid north coast, NSW(September 2009): *Blandfordia*
- Toowoomba, Qld (November 2009): waxflower and pearl flower (growers and QDPI staff)
- Mt Tomah, NSW (November 2009): waratahs (growers and NSW DPI staff)
- A major workshop was held in February 2009, Campbelltown in conjunction with the 2009 NSW wildflower conference – Thirty growers, exporters, wholesalers, researchers and representatives of a Japanese importer participated. Attendees worked in small groups to assess samples of 6 products with varying quality according to the draft specifications. They used the checklist prepared for assessing product quality at market entry point (wholesaler/exporter). The Campbelltown workshop also collected information on postharvest disinfestation methods, postharvest solutions and packing and labelling of boxes. This information has been included in the postharvest manual.

The workshops involved a total of eighty industry members. Formal feedback was very positive, with most participants noting that as a result they gained a better understanding of the specifications and how to use them. Most expected to get a significant benefit from the specifications and most found the workshops very to moderately useful.

Table 4. RIRDC publications produced by the project.

ISBN	RIRDC Pub No	Publication Title	Authors
978-1-74254-000-9	10/027	Postharvest Handling of Australian Flowers from Australian Native Plants and Related Species	John Faragher, Bettina Gollnow and Daryl Joyce
978-1-74254-001-6	10/028	Flannel flower	Ross Worrall and Bettina Gollnow
978-1-74254-002-3	10/029	Kangaroo paw	Ross Worrall and Bettina Gollnow
978-1-74254-003-0	10/030	Black kangaroo paw	Ross Worrall and Bettina Gollnow
978-1-74254-004-7	10/031	Baxter's banksia	Bettina Gollnow and Ross Worrall
978-1-74254-005-4	10/032	Scarlet banksia	Bettina Gollnow and Ross Worrall
978-1-74254-006-1	10/033	Hooker's banksia	Bettina Gollnow and Ross Worrall
978-1-74254-007-8	10/034	Menzies' banksia	Bettina Gollnow and Ross Worrall
978-1-74254-008-5	10/035	Hinchinbrook banksia	Bettina Gollnow and Ross Worrall
978-1-74254-009-2	10/036	Berzelia	Bettina Gollnow and Ross Worrall
978-1-74254-010-8	10/037	Boronia	Bettina Gollnow and Ross Worrall
978-1-74254-011-5	10/038	Christmas bush	Ross Worrall and Bettina Gollnow
978-1-74254-012-2	10/039	Waxflower	Bettina Gollnow and Ross Worrall
978-1-74254-013-9	10/040	Pearlflower	Bettina Gollnow and Ross Worrall
978-1-74254-014-6	10/041	Eucalyptus flowers	Bettina Gollnow and Ross Worrall
978-1-74254-015-3	10/042	Grevillea flowers	Ross Worrall and Bettina Gollnow
978-1-74254-016-0	10/043	Leptospermum	Bettina Gollnow and John Faragher
978-1-74254-017-7	10/044	Leucadendron 'Jubilee Crown'	Bettina Gollnow
978-1-74254-018-4	10/045	Safari Sunset	Bettina Gollnow
978-1-74254-019-1	10/046	Leucadendron 'Pisa'	Bettina Gollnow
978-1-74254-020-7	10/047	Leucospermum 'High Gold'	Bettina Gollnow
978-1-74254-021-4	10/048	Leucospermum 'Tango'	Bettina Gollnow
978-1-74254-022-1	10/049	Riceflower	Bettina Gollnow and Ross Worrall

978-1-74254-023-8	10/050	King protea	Bettina Gollnow and Ross Worrall
978-1-74254-024-5	10/051	Protea 'Pink Ice'	Bettina Gollnow and Ross Worrall
978-1-74254-025-2	10/052	Protea 'Grandicolor'	Bettina Gollnow
978-1-74254-026-9	10/053	Honey protea	Bettina Gollnow
978-1-74254-027-6	10/054	Blushing bride	Bettina Gollnow
978-1-74254-028-3	10/055	Scholtzia	Bettina Gollnow and Ross Worrall
978-1-74254-029-0	10/056	Waratah	Bettina Gollnow and Ross Worrall
978-1-74254-030-6	10/057	Thryptomene	Bettina Gollnow and John Faragher
978-1-74254-031-3	10/058	Christmas Bells	Bettina Gollnow
978-1-74254-032-0	10/059	Gynea lily	Ross Worrall and Bettina Gollnow

5. Implications

Through the quality specifications and postharvest manual developed by this project, growers, marketers and buyers throughout Australia, and also overseas, will have detailed and useful guidelines. Each specification is illustrated with high quality photos of stages of opening and typical defects to be avoided at market entry. The specifications and detailed product factsheets included in the manual will allow users to standardise the quality and consistency of 48 major wildflower products. If widely adopted, the current variability will be reduced and poor product will be harder to sell.

More consistent product quality brings several important market advantages:

- flowers of consistent and better quality will sell first, hopefully at a better price, improving profitability for growers and marketers
- flowers of the same species/type delivered by different growers is more consistent
- growers will not waste time and money harvesting, grading and shipping poor quality product
- new growers and new owners of established farms will have useful guidelines about harvesting and marketing
- shipments combining product from several growers are more uniform
- growers and marketers can receive feedback and can correct inconsistencies based on defined specifications supported by clear photos
- growers will have a marketing advantage if competing product from other grower(s) is of a lesser standard
- buyers can refer to the defined specifications and photos before shipment and on arrival.

The specifications developed by this project will be a model for other flowers. They also represent the first stage in developing a national quality management system for the wildflower industry.

By publishing the specifications and supporting manual on the web, they will be available to all, at no cost, including those who are further along the value chain (buyers such as importers and florists, and consumers) as well as potential investors, who will have a clearer idea of what the end product should look like. The accompanying photos will be especially important because they provide a clear idea of what is 'acceptable' and what is not. Printed specifications with high quality photographs are intended to become the common reference point for all industry members and can be purchased at a nominal cost.

In the highly competitive world floriculture market, attention is increasingly focussed on quality and good postharvest handling (especially cooling and hydration). This applies to all flowers. The specifications developed by this project have the potential to lift Australia's image as a consistent supplier of high quality wildflowers in local and world markets, benefitting those marketing Australian grown products. While there are many flower marketers in Australia, only some currently apply rigorous and high standards to the product they handle. Others aim to 'sell anything they can find a buyer for', and they will not see the need for these specifications. However, there is often intense competition between wholesalers and exporters for suppliers and buyers. These specifications will assist those focussed on quality who wish to recruit more suppliers or buyers.

The pressures of exporting (for example, currency exchange rates, high freight costs and growing competition from cheaper labour producers) have mounted significantly in recent years. Those who continue to market cheap products of variable quality will do less well than those who focus on selling higher value, higher quality products into niche markets. There is an economic imperative for exporters to accept the specifications and adapt them for their own customers.

Some quality problems seen in the market require a better understanding of wildflowers, which are botanically different from many flowers people are used to handling. For example:

- many products are complex flower heads composed of hundreds of florets – these may have pin-like styles that get tangled with each other or break off, or they may produce abundant nectar as they open
- many feature colourful bracts rather than petals
- wild harvested product may compete with cultivated product, but buyers don't know the difference
- some products change in appearance at different times of the year and look quite different – e.g. *Leucadendron* 'Safari Sunset' and 'Pisa'
- bypass growth and grow through can spoil product appearance.

This creates the potential for postharvest issues not encountered with other types of flowers. For example as the florets in a complex flower head (seen in *Banksia*, *Protea*, *Leucospermum* and *Grevillea*) develop and open, they draw on food reserves in leaves, they produce nectar (which in turn attracts birds and bees) and the appearance of the flower head changes completely.

This can result in several postharvest problems if not managed by the grower and/or the marketer:

- leaf blackening (in Proteas)
- abundant nectar in more open flowers brings an increased risk of botrytis rot in transit, and adding sugar to postharvest solutions can exacerbate this (e.g. in waratahs)
- some flowers do need a sugar pulse to maximise their vase life (e.g. kangaroo paws); but ants like sugar and need to be managed in the packing shed
- insects and birds are attracted to open flower heads and can completely destroy the flower structure (e.g. many proteas), so flowerheads need to be picked more closed
- complex flower heads may be heavily contaminated with insects and hard to disinfest, especially if exported
- the pin-like styles on opening florets are easily damaged, so the product needs to be bunched before too many are open, and sleeved.

Wildflowers *do* have things in common with other flowers:

- flowers picked too immature won't open and may wilt
- flowers picked too open have a short life and may drop flower parts (messy!)
- flowers under stress when picked won't last well
- some will 'hold' on the bush but others must be picked when they are at the right stage and reach end customer without delay
- cooling is critical – usually 2-4 °C to reduce water loss and slow ageing – but some species need to be held at slightly higher temperatures.

For these reasons, each product specification describes the product in detail, aiming to educate all users.

The project will also have a direct and positive effect on sustainability and biodiversity. If buyer confidence in Australian wildflower and native products is strengthened through these specifications, lesser quality cultivated or wild harvested flowers and foliage will lose market share. For certain products, reliable supplies of cultivated high quality product will reduce reliance on wild stands, as has already occurred for waratahs. This means wildlife licensing authorities may no longer issue licenses for wild harvest, with benefits for biodiversity through less picking and traffic in areas of native vegetation.

The postharvest manual provides clear advice on most aspects of postharvest handling and recommendations for wildflower crops and related species. We hope that the manual will be used as a practical workbook, a recipe book and a reference book. We envisage that the users will add to it.

The manual can be used for extension and education. It can be used to implement quality assurance practices and to develop quality assurance manuals. It can also be a valuable text for students who will later work in the industry.

Unfortunately there has been relatively little new postharvest research into wildflowers since the first edition was published. Specific areas requiring more research are listed in the Recommendations.

The practical issues and consequences surrounding registration and regulation of using agricultural chemicals need to be addressed more fully by the industry, with the support of the appropriate technical specialists. For example, very few pesticides are registered, approved or have permits for postharvest use on ornamentals or flowers. This means that in some States it is illegal to use them after harvest, while in other States it is not. The areas of permits for minor uses of agricultural chemicals and the regulations concerning disposal of chemicals are complex and differ between States. It is difficult for most people to obtain clear, authoritative advice on these matters.

6. Recommendations

For the quality specifications we recommend that:

1. growers, wholesalers, exporters and retailers apply the specifications to ensure only 'minimum acceptable' quality products are marketed
2. industry organisations such as WildFlowers Australia encourage their members to use the specifications
3. growers use the charts in the specifications to review their current product handling and postharvest practices and adapt them if necessary
4. growers ensure their procedures are appropriate for each product, e.g. they use anti-ethylene treatments if the flower is ethylene sensitive
5. the specifications are used as resource material for practical workshops and extension, to develop quality assurance practices and manuals and as an educational text
6. the specifications are promoted to buyers – e.g. Australian florists and overseas importers – to ensure they get the greatest value from the products in terms of vase life and consumer satisfaction
7. sellers accept product at the correct maturity stage, rather than marketing very open flowers which may have immediate eye appeal but a short vase life for their customers
8. the Australian wildflower industry updates these specifications and produces new ones as new products become established.

For the postharvest manual we recommend that:

1. growers, wholesalers, exporters and retailers use the manual to help implement good postharvest practices that will maintain and improve the quality of flowers
2. the manual is used as resource material for practical workshops and extension, to develop quality assurance practices and manuals and as an educational text
3. there is ongoing collaboration between R&D and extension workers and growers, exporters, wholesalers, importers and retailers to devise and implement good, practical postharvest treatments
4. the wildflower industry becomes actively involved with the appropriate authorities to ensure that accurate, simple advice on all issues related to regulation and use of agricultural chemicals is readily available to industry. The appropriate authorities are the APVMA and State Departments of Primary Industries and Environment Protection Authorities
5. industry applies for national minor use permits for use of selected insecticides and fungicides on cut flowers after harvest
6. the manual is updated, by users and the appropriate researcher(s), every three years with funds from industry, RIRDC and State Governments
7. the gaps in knowledge about postharvest treatments are filled in by strategic R&D, particularly:
 - postharvest treatments to maintain quality during marketing, e.g. hydrating, sugar, anti-ethylene and anti-fungal treatments

- the best practical postharvest treatments for a wider range of important flowers where this is not known already, including hydrating treatments, sugar pulses and anti-ethylene treatments, e.g. for *Banksia*, *Crowea*, *Eriostemon*, *Eucalyptus* and *Leptospermum* (tea tree)
- the best practical postharvest treatments are determined for new products concurrently with their horticultural and market development
- detailed postharvest biology of important species, including aspects such as ethylene sensitivity, abscission (flower and petal drop) and the importance of infection with *Botrytis* and other fungi
- how a wide range of flowers respond to ethylene and anti-ethylene treatments including the environmentally friendly product 1-MCP.

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- More extensive reference lists, used to write the specifications and the postharvest manual, are published in the postharvest manual.

Quality specifications for Australian wildflowers and revised manual of postharvest treatments for wildflowers

by John Faragher, Bettina Gollnow and Daryl Joyce

Publication No. 10/185

This report describes the development of a series of easy to use quality specifications for the major wildflower products traded on Australia's domestic and export markets (RIRDC Publication Numbers 10/028 to 10/059). These specifications describe the 'minimum acceptable' product specifications at market entry, using photos and easy to follow charts.

As an additional component of this work, the manual "Postharvest Handling of Australian Native Flowers and Related Species: A Practical Workbook" (RIRDC 2001) was extensively revised. This report describes the information included in the updated edition (RIRDC Publication Number 10/027) and how the manual has been written to support the specifications.

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