

final report

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Preparation and revision for 2nd Edition of the grazier manual ‘Leucaena - A guide to establishment and management’

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1 Executive summary

The book *Leucaena - A guide to establishment and management* was first published by MLA in 2006. Over 6000 copies have been sold or distributed to members and the book is available in electronic format online. The book has facilitated the transfer of robust practical information to graziers and has contributed to the adoption of leucaena-based pasture systems for finishing cattle. Importantly, the publication promotes the responsible use of leucaena for livestock, including the Code of Practice developed and advocated by The Leucaena Network. Since 2006, much new and important information has been generated and the manual required updating.

New information was sourced from a review of scientific publications (journal articles and theses), industry reports and discussion with colleagues. Project personnel also undertook numerous field trips to interview innovative leucaena growers throughout Queensland, collate best management practices and to take high quality photographs for incorporation into the revised manual. The University of Queensland also hosted the International Leucaena Conference 2018 in October/November 2018. Many leading Australian graziers and delegates from 12 countries attended the conference, providing reports on research, extension and development activities promoting the use of leucaena in multipurpose agroforestry systems. This valuable material has been incorporated into the book. Interesting international case studies have been included in a new section in the revised leucaena manual

A comprehensive update of the manual '*Leucaena – A guide to establishment and management*' has been prepared and submitted to MLA.

The production of the revised manual is timely, as the area of northern Australia where leucaena is being promoted expands. The release of the psyllid-tolerant leucaena variety cv. Redlands has enabled leucaena to be adopted by graziers in humid coastal environments. Many of these graziers have limited knowledge and experience of leucaena production systems. The revised manual will be an essential tool in facilitating successful establishment and management of leucaena pastures by new growers.

Recommendations – It is recommended that the additional chapters requested by MLA be completed and added to the revised manual. The revised manual in Word format is ready to be typeset, style edited and published. It is recommended that a print run (e.g. 1000-2000 copies) of hardcopies would aid promotion and awareness of the revised manual. Many producers prefer hard copy to electronic copy. It is recommended that the online version of the manual should be reviewed and updated every 3-5 years, or whenever new important and relevant information becomes available.

Table of contents

Preparation and revision for 2nd Edition of the grazier manual 'Leucaena - A guide to establishment and management'	1
1 Executive summary	2
2 Background	4
2.1 Why undertaken and significance to industry	4
2.2 Over-arching aims	4
3 Project objectives	4
4 Methodology	5
4.1 Grazier and specialist interviews	5
4.2 International Leucaena Conference 2018.....	5
4.3 Engagement with other agencies	5
4.4 Major revision of many chapters	6
4.5 Final documentation submitted.....	6
5 Results	6
6 Discussion	7
7 Conclusions/recommendations	9
8 Key messages	9
9 Bibliography	11

2 Background

2.1 Why undertaken and significance to industry

Leucaena is widely recognized as the most sustainable, and valuable multipurpose tree legume in the tropics. It is a productive and profitable source of protein for ruminant production. Over the past three decades, scientists and farmers have greatly increased their knowledge of this plant, resulting in new plantings that have increased exponentially over time. As a consequence, there is demand for improved knowledge of the latest varieties, recommended management practices and feeding systems.

The leucaena book, '*Leucaena - A guide to establishment and management*', was first published by MLA in 2006 (Dalzell *et al.* 2006). It has been an incredibly valuable extension tool with over 6000 copies sold or distributed to members. The book has facilitated the transfer of robust practical information to graziers and has contributed to the adoption of leucaena-based pasture systems for finishing cattle.

Importantly, the publication promotes the responsible use of leucaena for livestock feeding, including the Code of Practice developed and advocated by The Leucaena Network.

Since 2006, much new and important information has come from a variety of sources, namely: MLA funded R&D efforts principally from the University of Queensland, but also from QDAF and CSIRO, and from the many enterprising and innovative beef producers who are growing and grazing leucaena. The industry itself has experimented successfully with improved management approaches and much has been learnt from on-farm innovations. Similarly, in other countries such as Indonesia local practices involving feeding 100% leucaena diets to cattle have provide valuable information for Australian application.

2.2 Over-arching aims

There has been extensive new research conducted since the first edition was published in 2006. Areas of significant new knowledge include:

- Agronomy and management practices from latest version of "Leucaena for Profit and Sustainability" course notes.
- New varieties – cvv Redlands and Wondergraze
- Leucaena toxicity management
- Rooting depth, soil water use and competition with grass
- Comparative economic analysis with other forage crops and pasture systems
- Salinity tolerance – root zone and foliar tolerance to overhead irrigation
- Chemical control of unwanted/weed leucaena
- Greenhouse gas mitigation – soil carbon sequestration and methane emission reduction
- Ongoing development of new varieties to meet industry demand – namely sterile varieties.
- Nutrition of animals consuming leucaena
- Research and development outcomes in other countries, especially Indonesia, which are relevant to Australia

Accordingly, it was timely to update the content and layout of the leucaena book.

3 Project objectives

- Update the technical content of the 1st edition of the grazier manual '*Leucaena - A guide to establishment and management*' (Dalzell *et al.* 2006).

- Identify new content for 2nd edition and collate material, including case studies of current R&D activities and grower experiences.
- Revise the text, photographs, graphic design and images for the 2nd edition of the grazier manual '*Leucaena - A guide to establishment and management*' ready for typesetting/style editing.
- Identify publication and dissemination pathways that support adoption and impact for the beef industry.

Drs Max Shelton and Scott Dalzell were responsible for collecting and collating the additional information for the book update. They sought input and review from colleagues within the University, CSIRO, QDAF and from leucaena growers.

4 Methodology

4.1 Grazier and specialist interviews

Three week-long visits were made from May to September 2017 to leucaena growers and to leucaena specialists to gain updated information on the establishment and management of leucaena in Queensland. These visits were an excellent source of new material, photographs and case studies. The locations and dates of the visits were:

- Southern inland Queensland 21-26 May 2017
- Central Queensland 19-23 June 2017
- Northern Queensland 7-13 August 2017

4.2 International Leucaena Conference 2018

A very successful International Leucaena Conference 2018 (ILC2018) including a pre-conference field tour, was organized by The University of Queensland and staged from 29 October to 3 November 2018. The last dedicated conference on leucaena was held in Vietnam in 1997.

Approximately 120 conference delegates from 12 countries, comprising researchers, extension officers, consultants, producers and students, shared their research knowledge and practical experiences regarding leucaena. Many excellent speakers exchanged information regarding how to plant, manage and use leucaena around the world. Engagement and networking ensured there was enthusiastic and fruitful discussion on future priorities and collaborative opportunities. The presentations from this conference were extensively used as valuable source material when preparing the update of this book.

4.3 Engagement with other agencies

During the preparation of the book update extensive engagement was conducted with many relevant agencies which all provided useful materials. These agencies included:

- Queensland Department of Agriculture and Fisheries, Australia
- The Leucaena Network, Australia
- Meat and Livestock Australia
- The University of Queensland, St Lucia, Qld, Australia
- Department of Primary Industries and Regional Development, WA
- Commonwealth Scientific and Industrial Research Organization (CSIRO), Australia

- Tasmanian Institute of Agriculture, University of Tasmania, Burnie, Tasmania
- DOW Chemicals
- Department of Natural Resources and Environmental Management, University of Hawaii-Manoa, Honolulu, HI, USA
- Department of Biology, New Mexico State University, New Mexico, USA
- Faculty of Animal Science, University of Mataram, Mataram, Lombok, Indonesia
- Assessment Institute for Agricultural Technology, NTB, Indonesia
- Centro para la Investigación en Sistemas Sostenibles de Producción Agropecuaria, CIPAV, Cali, Colombia

4.4 Major revision of many chapters

Major revision was made to many sections including:

- Case studies and grazier experience (establishment, management and animal productivity gains)
- Cultivar descriptions for Wondergraze and Redlands
- Leucaena toxicity management
- Salinity tolerance of leucaena to root zone salinity and overhead irrigation with saline water
- Development of new varieties to meet industry needs (sterile leucaena varieties)
- Agronomy and management practices from latest version of "*Leucaena for Profit and Sustainability*" course notes
- Chemical control of weed leucaena
- Greenhouse gas mitigation – soil carbon sequestration and methane emission reduction, methodology for assessing emission reduction and C sequestration
- Rooting depth, soil water use and competition with grass
- Comparative economic analysis with other forage crops and pasture systems
- Compilation of regionally relevant case studies
- New chapters on nutritional aspects of leucaena and relevant activities in other tropical countries utilising leucaena.

4.5 Final documentation submitted

All updated sections of the book were completed in draft form ready for typesetting/style editing and supplied to MLA in Word format. These revised sections will also be submitted to the style editor for style editing including high resolution photographs, graphics and supplementary technical information. The optimal formatting, graphic design and layout was identified for primary and accompanying materials.

5 Results

All updated chapters in Word format are given in Appendix 1. Photographs were excluded to limit the file size of the Final Report. The contents of the updated book will be as shown in the table below.

Table of Contents

Foreword
Preface
Acknowledgements
Chapter 1 – Why plant leucaena?
1.1 What is leucaena?
1.2 Why plant leucaena?

1.3 Choose your market
Chapter 2 – Establishing leucaena
2.1 Where does it grow best?
2.2 Paddock selection and planning
2.3 Cultivar selection
2.4 Seed treatment
2.5 Land preparation
2.6 Planting
2.7 Soil insect control
2.8 Weed control
2.9 Companion grasses
2.10 Early grazing management
2.11 Further reading
Chapter 3 – Managing the leucaena plant
3.1 Mineral nutrition
3.2 Height management
3.3 The psyllid insect
3.4 Other insect pests
3.5 Irrigating leucaena
3.6 Further reading
Chapter 4 – Grazing management
4.1 Growing leucaena
4.2 Grazing leucaena
4.3 Making the best use of leucaena
4.4 Further reading
Chapter 5 – Animal nutrition
5.1 Nutritive value
5.2 Feeding supplements with leucaena
5.2 Leucaena toxicity
5.3 Further reading
Chapter 6 – Leucaena costs and returns
6.1 Costs of establishment
6.2 Gross margin analysis
6.3 Economics of irrigated leucaena
6.4 Further reading
Chapter 7 – Leucaena and the environment
6.1 Leucaena, greenhouse gases and soil carbon
6.2 Leucaena, salinity and water quality
6.3 Other benefits
6.4 Leucaena as an environmental weed
6.5 Soil acidification
6.6 Further reading
Chapter 8 – What is happening in other countries
8.1...Indonesia, Thailand, India and Latin America
8.2 Further reading

6 Discussion

The 2nd edition of the book '*Leucaena - A guide to establishment and management*' builds on the 1st Edition which was published in 2006. It updates and adds new information that has been generated by scientific research and grazier innovation over the last 13 years.

The revised book will provide the northern Australian beef industry with a valuable extension tool to facilitate best practice establishment and management practices. The further successful adoption of leucaena pastures will continue to enhance the profitability and sustainability of beef enterprises (Bowen *et al.* 2016).

Recommendations:

- Two (2) additional chapters of the book (Ruminant Nutrition and Environment) require preparation. This work could be undertaken concurrently while the completed sections of the book are typeset and style edited.
- The prepared chapters are ready for submission to a style editor for typesetting in preparation for publication. The final selection of high-quality photographs used in the book will be made during this stage.
- It is recommended that a limited print run (~1000-2000 copies) of hardcopies be prepared to aid in promotion of the book. It is anticipated that MLA will continue to provide access to an electronic (pdf) version of the manuscript via its website.
- A summary brochure has also been prepared in MLA format. Similarly, ~1000-2000 hardcopies of the brochure should be printed and distributed to graziers considering planting leucaena for the first time.
- The electronic version of the 2nd edition of the book should be reviewed and updated whenever significant new information becomes available.

A draft extension message could include the following statement:

"A revised second edition of the book '*Leucaena - A guide to establishment and management*' is now available from MLA. It is a valuable resource for both new and experienced growers alike. The book provides graziers with best practice information on the establishment and management of leucaena pastures. Following the guidelines in the book will enable graziers to successfully integrate highly productive leucaena pastures into their beef enterprises. It is a 'must read' for anyone interested in pasture improvement in northern Australia. Limited numbers of hardcopies are available, and the book is also available in electronic format from the MLA website (insert url address)."

The following project objectives have been met as follows:

- **Updated the technical content of the 1st edition of the grazier manual '*Leucaena - A guide to establishment and management*'.**
This objective has been met as the original material of the 1st Edition has been thoroughly reviewed, and where required updated.
- **Identified new content for 2nd edition and collate material, including case studies of current R&D activities and grower experiences**
Much new material has been added to the 2nd Edition including:
 - Description and application of new varieties of leucaena;
 - Practical recommendations for monitoring and managing plant nutrition in leucaena pastures;
 - Complete overhaul of the chapter on the economics of growing leucaena
 - New or updated case studies from innovative graziers;
 - Brief relevant international case studies on leucaena feeding systems have also been provided;
 - Better photographs have been used throughout; and
 - 'Further reading' lists for each chapter have been provided to refer graziers to more detailed information
 - Two new chapters: one on nutritional aspects of leucaena for ruminants, and the other on a revamped chapter on environmental aspects of leucaena.

MLA has requested that a ruminant nutrition and refocused environmental section be added to the finalised manuscript prior to typesetting, style editing and publishing. These additional chapters are outside the scope of the project and should be completed as a separate activity.

- **Revised the text, photographs, graphic design and images for the 2nd edition of the grazier manual 'Leucaena - A guide to establishment and management' ready for typesetting/style editing.**
With the exception of the ruminant nutrition and refocused environmental sections, this objective has been completed. Preliminary feedback from Mr Ian Partridge regarding typesetting and style editing conforming to MLA requirements has been sought.
- **Identified publication and dissemination pathways that support adoption and impact for the beef industry.**
A number of pathways to promote and distribute the revised book to industry have been identified and supporting parties (e.g. The Leucaena Network) engaged.

7 Conclusions/recommendations

The update of the technical and practical information contained within the second edition of the manual '*Leucaena - A guide to establishment and management*' is complete.

It is recommended that the additional chapters be completed and added to the revised manual which can now be typeset, style edited and published. It is recommended that a print run (e.g. 1000-2000 copies) of hardcopies would aid promotion and awareness of the revised manual. Many producers prefer hard copy to electronic copy. Printing specifications recommended by Ian Partridge are:

- 120 pp plus 2 pp Cover
- Cover Printed CMYK + 1 Spot Colour, 1 Side on 250 gsm Satin Art
- Matt Cello Cover 1 Side
- Pages Printed CMYK Throughout on 115 gsm Satin Art
- Perfect Bind & Trim to A4

Distribution of the book is recommended through the following avenues:

- Maintenance of an online version available for free download from the MLA website;
- Ongoing promotion and distribution through MLA publications (e.g. Feedback), sponsored events and training courses;
- Promotion of the book as an online resource by Government extension agency programs and personnel; and
- Promotion of the book as an online resource by The Leucaena Network.

The online version of the manual should be reviewed and updated every 3-5 years, or whenever new important and relevant information becomes available.

8 Key messages

A revised edition of '*Leucaena - A guide to establishment and management*' is ready for style editing, publication and distribution to graziers, advisors and extension personnel across Northern Australia. The updated book will provide graziers with practical information to facilitate their successful adoption of leucaena pastures.

Expanding the area of new leucaena, and increasing the productivity of existing leucaena, will have a significant impact on the sustainability and profitability of beef enterprises in Northern Australia.

9 Bibliography

Bowen MK, Chudleigh F, Buck S, Hoptins K (2016) Productivity and profitability of forage options for beef production in the subtropics of northern Australia. *Animal Production Science*, published online. <http://dx.doi.org/10.1071/AN16180>

Dalzell SA, Shelton HM, Mullen BF, Larsen PH, McLaughlin KG (2006) 'Leucaena: a guide to establishment and management.' (Meat and Livestock Australia: Sydney