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GRDC
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GRDC
GRAINS RESEARCH
& DEVELOPMENT
CORPORATION

LENTIL

SECTION 1

INTRODUCTION

KEY POINTS | KEYS TO SUCCESSFUL LENTIL PRODUCTION | THE ROLE OF PULSES IN THE FARMING SYSTEM | WHY GROW LENTIL? | CROP OVERVIEW | PRODUCTION | GRDC'S LENTIL INVESTMENT

Introduction

Key points

- Lentil usually commands a premium price compared to other pulse crops.
- Lentil fits well into cereal-based cropping systems.
- Lentil is mostly used for human consumption.
- Canada is the largest producer of lentil in the world.
- In Australia, lentil is predominantly grown in the semi-arid regions of South Australia and Victoria.
- Small areas of lentil are now being grown in southern New South Wales (and also Western Australia).
- Australia is a significant producer of red lentil.
- The area in Australia planted to green lentil is gradually increasing, as are the speciality types.

FEEDBACK

Keys to successful lentil production

- Paddock selection is critical. Choose free-draining soil with neutral to alkaline pH, and minimal sodicity, salinity and boron toxicity. Consider herbicide residues, likely weed presence and available weed-control options.
- Having adequate moisture for the plant to grow tall enough to be harvestable is essential. Sowing systems that retain stubble, thus aiding in reducing evaporation losses from the soil, are recommended. Consider inter-row sowing into standing cereal stubble. This helps lentil plants to grow tall and erect, making harvest more efficient.
- In choosing varieties factor in maturity, disease resistance, sowing time and farming system used. Consideration must be paid to market type, end user and delivery point when selecting varieties. Consider forward contracts if on-farm storage is not available.
- Always use quality seed and stick to recommended sowing depth (2–6 cm).
- Sowing on time (late April to May) is important to maximise yields, especially in drier situations.
- In wetter situations in southern Australia, lentil can be sown much later without significantly affecting yield. Increase the sowing rate if sowing is very late.
- Use a sowing rate that is likely to achieve a plant density of 120 plants per square metre (approximately 50–60 kg seed/ha for medium-sized seed).
- Inoculate seed with Group F rhizobia (Group E can also have some efficacy) and supply adequate nutrition (fertiliser).
- Manage pests and weeds during the crop's establishment and early growth. Monitor crops regularly for pests.
- Control foliar diseases through careful paddock selection (avoiding recent pathogen inoculum), crop canopy management and strategic fungicide applications as required.
- High humidity and excessive rainfall during the growing season encourage vegetative growth, which limits yield and can reduce seed quality.
- Excessive drought and/or high temperatures during flowering and pod-fill also reduce yields.
- Harvest as soon as the crop is mature. Lentil crops can turn brittle once fully matured and can be prone to shattering, especially following summer rainfall.
- To maximise grain quality, handle the grain carefully and avoid equipment blockages.
- Harvest during cooler conditions to improve harvest efficiency and reduce the risk of fire.
- Consider on-farm storage of lentil grain to enable access to more lucrative markets after harvest.[1]

1 Grains Research and Development Corporation (2016) Lentils: The Ute Guide. Grains Research and Development Corporation, https://grdc.com.au/resources-and-publications/all-publications/publications/2008/11/lentils-the-ute-guide

FEEDBACK

1.1 The role of pulses in the farming system

MORE INFORMATION

A GRDC video on the value of pulses in the farming system is at https://youtu.be/ZfbW40oP0SI

Pulses have a role in the modern farming system far greater than the traditional nitrogen fixation and disease break they are best known for. They are a cash crop in their own right, and also a valuable part of the whole farming system, especially for weed control within crop rotations.

Stubble retention is commonly used for erosion protection and moisture retention, and pulses fit well into such systems. Machinery used in no-till or minimum-tillage systems can now handle stubble retention, which allows pulse crops to be sown after a cereal.

Diversity of crops in a rotation is important for continuous cropping systems:

- to handle herbicide-resistant weeds, or delay the onset of herbicide resistance by varying herbicide options and timings for weed control;
- to control disease in all crops in the rotation;
- to spread the timing of farm operations;
- to spread risk across commodities; and
- to minimise the impact of increased costs of fertiliser nitrogen and fuel.[2]

Photo 1: *A lentil crop.*

2 J Lamb, A Poddar (2008) Grain Legume Handbook for the Pulse Industry. Grain Legume Hand Book Committee, https://grdc.com.au/grainlegumehandbook

FEEDBACK

1.2 Why grow lentil?

Lentil is a versatile and lucrative pulse crop in south-eastern Australia that offers a number of financial and rotational benefits in many cropping systems.

1.2.1 Economics of lentil production

Lentil usually commands a premium price compared to other pulse crops, such as pea and faba bean, with many world markets demanding lentil graded for human consumption. Lentil has recently (2014 to 2015) sustained high grain prices of $800 to 1200 a tonne. These prices are up to two to three times the average long-term (2004–2014) price. This has been due to short world supply.[3]

Although lentil prices are often higher than most other pulses (faba bean, lupin and field pea), they can be volatile due to fluctuating production world-wide. This is particularly true for countries that export close to 100% of their crop production, such as Canada and Australia.

In addition to changes in world demand and carryover surpluses, lentil that fails to meet human consumption grade may suffer a significant price drop due to potential lack of livestock feed markets.[4]

Photo 2: *Lentil plants up close.*

3 Pulse Australia (2016) Southern Lentil: Best Management Practices Training Course. Pulse Australia.

4 Pulse Australia (2015) Best Management Guide – Lentil Production: Southern Region. Pulse Australia, http://www.pulseaus.com.au/growing-pulses/bmp/lentil/southern-guide

FEEDBACK

1.2.2 Lentil in the rotation

There are a number of **advantages** of having lentil in the rotation:

1. Lentil is a pulse break crop that can be used in rotations to effectively break the life cycle of cereal root diseases such as take-all, cereal cyst nematode and Rhizoctonia.
2. Lentil plants 'fix' their own nitrogen.
3. The shallow root system of the lentil plant, combined with a shorter growing season, means that soil moisture at depth is not fully extracted.
4. Compared to other winter crops, such as wheat or canola, the sowing window for lentil can be either early or late, depending on geographic location and variety. This can increase management options and help with the pre-sowing control of problem winter weeds.
5. In higher rainfall areas, lentil provides an opportunity to generate income from late-sown paddocks where seasonal conditions prevented the establishment of other winter crops.
6. Growing lentil can provide some management flexibility as selecting varieties with differing maturities can help spread peak demands on labour and machinery over a longer period of time.
7. Lentil fits well into cereal-based cropping systems, particularly when stubble is retained, with minimal additional machinery being required.
8. Lentil may also be sown as an opportunity crop into new areas or outside the optimum window and still produce economic yields. Examples include sowing in low-rainfall areas into a full profile of moisture following summer rainfall, sowing in spring to replace failed winter crops in a high-rainfall area, or delaying sowing to achieve better weed control.

Disadvantages of lentil in the rotation include:

1. Lentil does not have an extensive, deep root system to break up hard-pans and create channels in the soil profile that facilitate air and water movement like canola and safflower.
2. Lentil does not grow well on soils prone to waterlogging, boron toxicity or salinity.
3. Lentil is susceptible to fungal diseases such as Ascochyta blight and Botrytis grey mould.
4. Most lentil varieties are sensitive to carryover residues of Group B and Group I herbicides. PBA Herald XT$^{\Phi}$ and PBA Hurricane XT$^{\Phi}$ have herbicidal tolerance to imazethapyr when applied pre or post-emergence as per APVMA PER14369. This permit is valid until 31 August 2017. At least one product (Gemfarm imazethapyr 700wg) is now registered for use in Herald XT$^{\Phi}$ and Hurricane XT$^{\Phi}$.
5. The need to harvest the crop as soon as it is mature may be a problem for some growers, particularly larger-scale operations.[5]

5 Pulse Australia (2015) Best Management Guide – Lentil Production: Southern Region. Pulse Australia, http://www.pulseaus.com.au/growing-pulses/bmp/lentil/southern-guide

FEEDBACK

1.3 Crop overview

1.3.1 History

Lentil (*Lens culinaris*) is one of the oldest domesticated crops. Originating in south-west Asia, lentil has formed part of the human diet since the beginning of agriculture.[6]

In Australia, lentil is an established, high-value pulse crop, first grown commercially in 1994.[7]

Lentil is mainly grown in the semi-arid regions of Victoria and South Australia with winterdominant rainfall patterns. Lentil consumption in Australia is gradually increasing however it is widely grown and consumed throughout the Mediterranean, the Indian subcontinent, southern Asia, and northern America.

1.3.2 Lentil end uses

Lentil is mostly used for human consumption. Compared to other pulses, lentil tends to have lower protein quality due to its low levels of sulfur amino acids and tryptophan. However, the protein is highly digestible. Lentil is lower in fat than chickpea and is a good source of iron. Lentil has a shorter cooking time than other pulses.

With approximately one-quarter of its calorific value coming from protein content, lentil (and most other pulses and legumes) is third only to soybeans and hemp in its level of protein by weight. As such a rich protein source, lentil forms an essential part of regular diet in many parts of the world, notably in the Indian subcontinent where vegetarian diets are common and fresh meat is expensive.[8]

Photo 3: *A sample of lentil.*

6 Centre State Exports (2016) Crops Marketed: Lentils. Centre State Exports Pty Ltd, http://www.centrestateexports.com.au/services/lentils.aspx

7 R Thyer (2016) Lentils push geographic boundaries. Grains Research and Development Corporation, https://grdc.com.au/Media-Centre/Ground-Cover-Supplements/Ground-Cover-Issue-125--Pulse-breeding-advances/Lentils-push-geographic-boundaries

8 Centre State Exports (2016) Crops Marketed: Lentils. Centre State Exports Pty Ltd, http://www.centrestateexports.com.au/services/lentils.aspx

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1.3.3 Lentil types

Lentil varieties differ physiologically by seed size, seed coat colour, kernel (cotyledon), colour and time to maturity. Australia is a significant producer of red lentil and the area planted to green lentil is gradually increasing, as is the area of specialty lentils such as 'Duy', 'Black' and 'Spanish'.

Red lentil, sometimes known as 'small' or 'Persian' lentil, is the most widely grown in Australia. It is sold split for cooking (Masur dhal). The name 'red lentil' is derived from the red kernel (cotyledon) colour, which is exposed when split and the seed coat removed. The seed coat colour varies from light grey, through brown to black, and may be speckled. Seed size is generally 4–6 mm in diameter, and red lentil varieties are classified as either small, medium or large-seeded types.

Green lentil, also known as 'large' or 'Chilean' lentil, is used whole for cooking. The seed coat is green to brown and the kernel (cotyledon) is yellow. Seed size is generally 4.5–8 mm in diameter.

Red and green lentil grains should not be mixed, nor should red lentil of different size categories be mixed.

Niche varieties for local and export markets (restaurant and specialist uses) are developing. Locally adapted varieties of these types are grown in small quantities under contract. These include Spanish varieties.[9]

Photo 4: *Good quality lentil seed.*

Photo: Paul Jones

9 Grains Research and Development Corporation (2016) Lentils: The Ute Guide. Grains Research and Development Corporation, https://grdc.com.au/resources-and-publications/all-publications/publications/2008/11/lentils-the-ute-guide

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1.4 Production

1.4.1 World lentil production

Lentil is grown throughout the world. World lentil production for 2013 was 4,975,621 metric tonnes, primarily coming from Canada, India and Australia.[10]

About a quarter of worldwide production of lentil comes from India, most of which is consumed in the domestic market. Canada is the largest export producer of lentils in the world.

Table 1: Lentil production ('000 mt) for selected major producers.

Crop Year/Country	2013–14	2014–15	2015–16	2016–17	2017–18
Australia	246	250	260	900	550
Canada	1,886	1,987	2,373	3,581	3,600
United States	198	153	240	450	450
Turkey	305	345	425	450	450
Syria	10	10	10	5	5
Morocco	30	60	55	35	35
India	425	585	800	825	825
Bangladesh/ Pakistan	85	90	90	90	90
Other	600	600	600	600	600
Total	3,785.3	4,080.0	4,853.0	6,416	6,605

1.4.2 Australian lentil production

Australia's lentil industry has benefited from the release of ever-improving varieties, which offer wider adaption, improved agronomic features, plant physiology, plant architecture and yield. These varieties, along with improved crop-management techniques, provide growers with the confidence to grow this high-value crop.

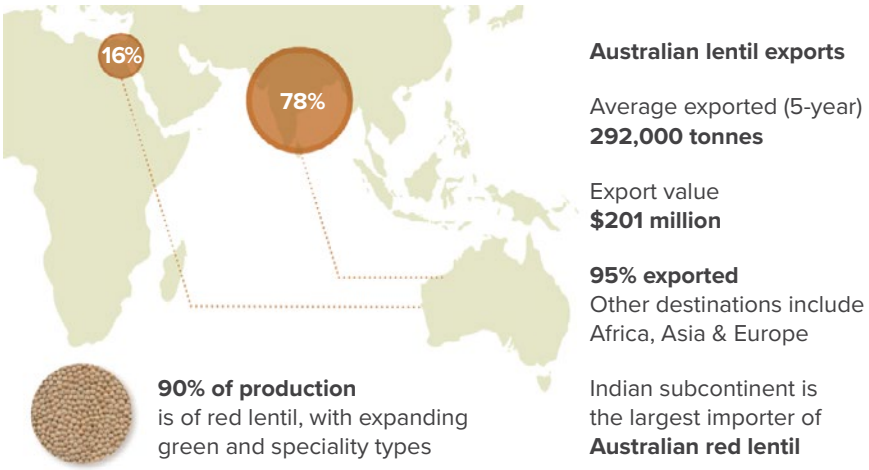

Figure 1: *Australian lentil production and exports.*

Source: P Semmler (2016), Pulse market update factors likely to impact supply demand and pricing in the next six to twelve months, (2016), Grains Research and Development Corporation, https://grdc.com.au/Research-and-Development/GRDC-Update-Papers/2016/08/Pulsemarket-update-factors-likely-to-impact-supply-demand-and-pricingRole of lentils in southern region farming systems

MORE INFORMATION

Information on the Australian pulse industry, including lentil, can be found in a GRDC update paper 'Viable growth in the pulse industry'see https://grdc.com.au/resources-and-publications/grdc-update-papers/tab-content/grdc-update-papers/2016/02/viable-growth-in-the-pulse-industry

10 United Nations Food & Agriculture Organization, Statistics Division (2016) http://faostat3.fao.org/home/E

FEEDBACK

MORE INFORMATION

Visit the GRDC website for information on maximising pulse performance in South Australian farming systems. https://grdc.com.au/resources-and-publications/grdc-update-papers/tab-content/grdc-update-papers/2016/02/maximising-pulse-performance-in-south-australian-farming-systems

Or for information on pulse opportunities in the Mallee see https://grdc.com.au/resources-and-publications/grdc-update-papers/tab-content/grdc-update-papers/2015/07/new-opportunities-for-pulses-in-the-mallee

A GRDC Video on pulse breeding 'Pulse Breeding Australia Retrospective' is at https://grdc.com.au/archive/video/2011/07/gctv4-july2011/tmmloc9gsm0

Lentil in Australia is predominantly grown in the semi-arid regions of South Australia and Victoria with winter dominant rainfall patterns. Specifically, this is the Victorian Wimmera and Mallee areas, and the mid-north and Yorke Peninsula of South Australia.[11, 12]

The traditional growing area for lentil has expanded and is now being grown in low-rainfall, Mallee-type environments.[13]

Small areas of lentil are now being grown southern New South Wales (and Western Australia).

1.5 GRDC's lentil investment

The breeding strategy for pulse crops as a whole (including lentil) has been driven since 2006 by Pulse Breeding Australia (PBA).

PBA is an unincorporated joint venture between:

- the Department of Economic Development, Jobs, Transport and Resources, Victoria (DEDJTR);
- the South Australian Research and Development Institute (SARDI) ;
- the Department of Agriculture and Fisheries Queensland (QDAF);
- the New South Wales Department of Primary Industries (NSW DPI);
- the Department of Agriculture and Food Western Australia (DAFWA);
- the University of Adelaide;
- the University of Sydney;
- Pulse Australia; and
- the Grains Research and Development Corporation (GRDC).

Prior to 2006 the lentil breeding investment was conducted through the Coordinated Improvement Program for Australian Lentils (CIPAL).

Before Australia's lentil breeding strategy was driven by PBA, an Australian lentil improvement program had been ongoing for some time, with the last GRDC project completed in 2000. During the last two years of the final project (2004–2006), three new varieties were released (Cumra, Cassab, and Nugget), all being selected from imported lines.

Genotypes with traits such as early flowering, high vigour, increased height, lodging resistance, Asochyta blight resistance, Botrytis grey mould resistance, tolerance to high soil boron and superior quality had been identified through CIPAL. These genotypes gave the period of investment a sound base to produce further improvements in new varieties.

The principal outputs of these lentil investments by the GRDC have been improved varieties. Important traits from these improved varieties have been yield, yield stability and disease resistance. Improvements in these traits were delivered in the new varieties released from 2008 to 2012. Further improvements are expected in releases between 2012 and 2016. Higher yields and increased disease resistance can translate into higher profits from the lentil crop, in turn potentially increasing the attractiveness of lentil in rotations.

The total investment by the GRDC of $20 million (present value terms) has been estimated to produce total gross benefits of $60 million (present value terms) providing a net present value of $40 million.[14]

11 J Brennan, A Aw-Hassan, K Quade, T Nordblom (2002) Impact of ICARDA Research on Australian Agriculture. Economic Research Report No. 11, NSW Agriculture. http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0004/146461/err-11-Impact-of-ICARDA-Research-on-Australian-Agriculture.pdf

12 R Thyer (2016) Lentils push geographic boundaries. Grains Research and Development Corporation, https://grdc.com.au/Media-Centre/Ground-Cover-Supplements/Ground-Cover-Issue-125--Pulse-breeding-advances/Lentils-push-geographic-boundaries

13 R Thyer (2016) Mallee growers break through cereals' ceiling. Grains Research and Development Corporation, https://grdc.com.au/Media-Centre/Ground-Cover/Ground-Cover-Issue-125-NovemberDecember-2016/Mallee-growers-break-through-cereals-ceiling

14 Grains Research and Development Corporation (2013) An Economic Analysis of GRDC Investment in the Lentil Breeding Program, GRDC. https://grdc.com.au/Research-and-Development/Impact-Assessment