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GRDC GROWNOTES™

GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

LUPIN

SECTION A

INTRODUCTION

CROP OVERVIEW | TYPES OF LUPIN GROWN IN WA | PRODUCTION HISTORY IN WA | MARKETS | KEY AGRONOMIC MANAGEMENT FACTORS TO OPTIMISE LUPIN YIELDS AND PROFITS IN WA | KEYWORDS

MORE INFORMATION

DPIRD Lupin Hub: https://www.agric.wa.gov.au/crops/grains/lupins

GRDC Pulse Australia 'Australian Pulse Crop Forecasts': http://pulseaus.com.au/storage/app/media/industry/20160613_AU-pulse-cropforecast.pdf

Lupins.org: www.lupins.org

DPIRD 'Guide to Growing Lupins': https://www.agric.wa.gov.au/lupins/lupin-essentials-%E2%80%93-growing-successful-lupin-crop

DAFWA 'Bulletin 102008 Producing Lupins': http://researchlibrary.agric.wa.gov.au/cgi/viewcontent.cgi?article=1009&context=bulletins

GRDC Final Reports: https://grdc.com.au/research/reports

GRDC Project Summaries: https://grdc.com.au/research/projects

Introduction

A.1 Crop overview

Western Australia is the nation's biggest producer and exporter of lupin grain, which is estimated to be worth about $120-150 million to the State's economy annually.

About 632,000 tonnes of lupin grain were harvested in WA in 2015, making this the State's highest volume pulse crop and about 80 percent of total national production.[1] The Australian Government Department of Agriculture and Water Resources' Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES) forecasts that WA will produce 545,000 t of lupin grain in 2016-17 from about 361,000 hectares (an 11 percent increase in area from 2015-16).[2]

Lupin is uniquely suited to the acid and sandy soils found across large tracts of WA's grainbelt and has a key role in breaking cereal disease cycles and adding fixed nitrogen (N) to soil for broadacre cropping systems.

Early research into lupin production by Dr John Gladstones at The University of Western Australia (UWA) in 1954 and application of the crop in sandplain areas by Sir Eric Smart at Mingenew led to significant tracts of previously unproductive soils being opened up for crop and cereal production in WA.

This was the forerunner to the highly successful modern wheat:lupin cropping system.

A.2 Types of lupin grown in WA

A.2.1 Narrow leafed lupin

Figure 1: *Narrow leafed lupin makes up the bulk of Western Australian lupin plantings.*

(SOURCE: GRDC)

1 Pulse Australia (2015-16) Australian Sweet Lupin Production 2010-11 to 2015-16, http://www.pulseaus.com.au/growing-pulses/publications/marketing-pulses#lupin

2 ABARES (2016) Australian Crop Report: September 2016 No.179, ABARES, http://www.agriculture.gov.au/abares/publications/display?url=http://143.188.17.20/anrdl/DAFFService/display.php?fid=pb_aucrpd9aba_20160913_NmxJS.xml

Narrow leafed lupin varieties (*Lupinus angustifolius*), also known as Australian sweet lupin, make up about 95 percent of production in the western region.

In 2016, Pulse Australia estimated 353,000 ha of WA farming land was sown to narrow leafed lupin and expected grain production was 611,500 t.[3]

The Geraldton port zone had the highest estimated plantings of these varieties, at 180,000 ha, followed by Kwinana West at 100,000 ha, Albany at 39,000 ha, Kwinana East at 25,000 ha and Esperance at 9000 ha.[4]

Breeding advances by the Department of Primary Industries and Regional Development (DPIRD) – formerly the Department of Agriculture and Food Western Australia (DAFWA) – have led to the development of narrow leafed lupin with better environmental adaptation, yield potential, disease resistance (including to anthracnose) and resistance to the phomopsis fungus that causes lupinosis in grazing animals.

Australian Grain Technologies (AGT) has taken DPIRD's successful lupin breeding program forward from 2016. It will continue to develop varieties that deliver higher returns to growers through improved yields, disease resistance, adaptation, herbicide tolerance and seed quality.

MORE INFORMATION

Pulse Australia's latest Australian Pulse Crop Forecasts can be found at: http://pulseaus.com.au/storage/app/media/industry/20160613_AU-pulse-crop-forecast.pdf

A.2.2 Albus lupin

Figure 2: *Albus lupin is grown in Western Australia, mainly for export.*

(SOURCE: GRDC)

Albus lupin (*L. albus*), also known as European white lupin, was grown in WA prior to anathracnose disease outbreaks in the mid-1990s.

In the past decade, new varieties with anthracnose resistance have been released, but this remains a minor crop in this State.

Pulse Australia estimated there were 7500 ha sown to albus varieties in the western region in 2016 and expected grain production was 13,600 t.[5]

The Geraldton port zone had an estimated 5500 ha sown to albus lupin and the Kwinana West port zone had the balance of 2000 ha.[6]

3 Pulse Australia (June 2013) Australian Pulse Crop Forecast, http://pulseaus.com.au/storage/app/media/industry/20160613_AU-pulse-crop-forecast.pdf

4 Pulse Australia (June 2013) Australian Pulse Crop Forecast, http://pulseaus.com.au/storage/app/media/industry/20160613_AU-pulse-crop-forecast.pdf

5 Pulse Australia (June 2013) Australian Pulse Crop Forecast, http://pulseaus.com.au/storage/app/media/industry/20160613_AU-pulse-crop-forecast.pdf

6 Pulse Australia (June 2013) Australian Pulse Crop Forecast, http://pulseaus.com.au/storage/app/media/industry/20160613_AU-pulse-crop-forecast.pdf

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MORE INFORMATION

Pulse Australia's Lupin hub is at: http://www.pulseaus.com.au/growing-pulses/bmp/lupin

A.2.3 Yellow and pearl lupin

Figure 3: *Yellow lupin was popular in WA in the 1990s but production is now minimal.*

(SOURCE: GRDC)

Yellow lupin (*L. luteus*) was popular during the 1990s when DPIRD – then DAFWA – researchers noticed it had high levels of resistance to common diseases and good tolerance of very acid soils. But only small areas are now sown to this species.

DPIRD is currently investigating the potential for high oil content pearl lupin (*L. mutabilis*) to be grown in parts of WA for grain production.

A.2.4 WA blue lupin

Figure 4: *WA blue lupin is considered a weed in most areas of the State.*

(SOURCE: GRDC)

WA blue lupin (*L. cosentinii*), or sandplain lupin, retains the wild lupin characteristics of bitter seed, hard-seededness and shattering pods.

This is considered to be a weed by lupin and other grain growers, with seed contaminating narrow leafed lupin crops and plants being a potential source of anthracnose.

But WA blue lupin is part of pasture systems in some western parts of the northern agricultural zone.

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MORE INFORMATION

DPIRD Guide to Growing Lupins: https://www.agric.wa.gov.au/lupins/lupin-essentials-%E2%80%93-growing-successful-lupin-crop

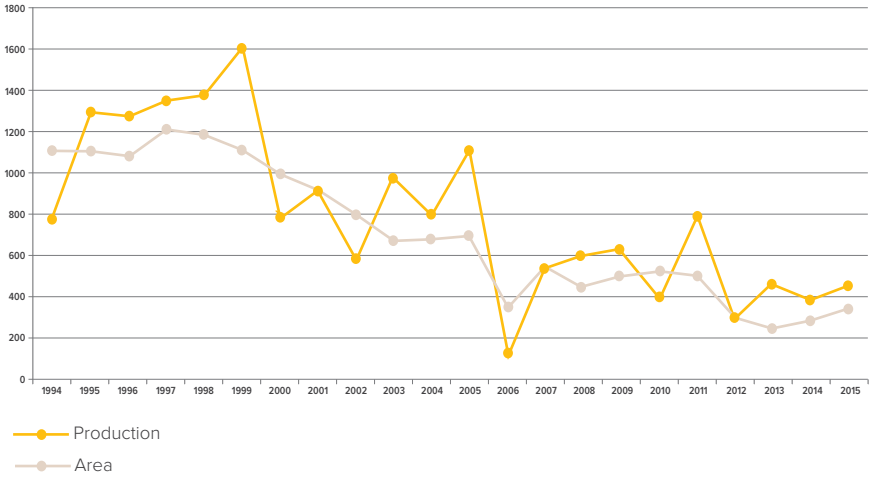
A.3 Production history in WA

The area sown to lupin crops in WA increased during the three years to 2016, after a steady decline since the late 1990s due to weed and disease issues and low grain prices.

Many growers substituted lupin in the crop sequence with more profitable canola, more cereals or even a fallow in low rainfall areas.

DPIRD estimates WA lupin production fell from a peak of 1.5 million tonnes in 1999 to a low of just over 200,000 t in 2006, as can be seen in Figure 5.

Figure 5: *Western Australian lupin area and production 1994-2015*



(SOURCE: DAFWA)

Since the release of the first fully domesticated Australian sweet lupin in the late 1960s, lupin breeding by DPIRD has resulted in a doubling of average lupin yields from 0.7 to 1.5 t/ha in WA.[7]

But lupin crops grown on good sandplain country, especially in the northern agricultural region, can produce average yields of about 3 t/ha (similar to wheat yields in those areas).

A.4 Markets

WA narrow leafed lupin grain exports are mainly sold for use as animal feed to key markets in the European Union, Japan and Korea.

Lupin competes with soybeans in export markets and is typically valued at 70–75 percent of the price of soybean meal.[8]

It is estimated just under half of the State's narrow leafed lupin grain production has historically been retained on-farm for use as stock feed or planting seed, or traded to domestic buyers.

There has been growing international interest in the use of lupin grain – processed to flour or flakes – for human consumption, as it is uniquely high in protein (30-40 percent) and dietary fibre (30 percent) and low in starch.

This means it has a low glycaemic index (GI) and could help to combat obesity and associated health problems of diabetes and heart disease.[9]

7 Pulse Australia (2015-16) Australian Sweet Lupin Production 2010-11 to 2015-16, http://www.pulseaus.com.au/growing-pulses/publications/marketing-pulses#lupin

8 Pulse Australia website (2016) Pulses: Understanding Global Markets, http://www.pulseaus.com.au/growing-pulses/publications/marketing-pulses#lupin

9 Pulse Australia website (2016) Pulses: Understanding Global Markets, http://www.pulseaus.com.au/growing-pulses/publications/marketing-pulses#lupin

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MORE INFORMATION

DAFWA Bulletin 102008 'Producing Lupins': http://researchlibrary.agric.wa.gov.au/cgi/viewcontent.cgi?article=1009&context=bulletins

A.5 Key agronomic management factors to optimise lupin yields and profits in WA

A.5.1 Paddock selection

- Sandy textured soils with pH 4.5 – 7 (Calcium Chloride – $CaCl_2$) are ideal
- Avoid saline, waterlogging-prone, alkaline and shallow duplex soils
- Avoid soils with free lime present
- Ensure a relatively low weed burden
- Avoid paddocks close to big areas of WA blue lupin
- Retain stubble.

(SOURCE: DPIRD) [10]

A.5.2 Variety selection

- Consider soil/environment
- Assess disease risk
- Test seed for germination, seed size, vigour, presence of Cucumber mosaic virus (CMV) and anthracnose
- WA's newest narrow leafed varieties are PBA Jurien$^{\Phi}$, PBA Leeman$^{\Phi}$ PBA Barlock$^{\Phi}$ and PBA Bateman$^{\Phi}$
- WA's newest albus variety is Amira$^{\Phi}$.

A.5.3 Sowing windows and conditions

- Sow as early as possible
- In the north, any time after mid-April
- In the south, from early May
- Don't sow after the first week of June in the north
- Dry sowing facilitates the longest growing season
- Dry sowing enables rapid crop establishment in warm soil
- Dry sowing can adversely affect simazine incorporation and weed control
- Dry sowing is best in paddocks with good stubble cover and low weed burdens
- Wet sowing (on a break of 15 millimetres over two days) improves crop germination
- Simazine can be washed into the soil by opening rains and improve weed control
- Delayed sowing until after the break allows the use of knockdown herbicides
- This is cost-effective and improves herbicide efficacy
- Delayed sowing reduces risks of a false break.[11]

A.5.4 Sowing rate and depth

- Aim for plant density of 40-45 plants/square metre
- This will suppress weed growth, improve crop competition and optimise yields
- Higher plant densities reduce disease pressure
- Harvesting can be easier in dense crops
- Sow seeds 3-5 cm below the soil surface
- Deeper sowing (below 5 cm) can reduce incidence of pleiochaeta root rot
- Shallower sowing (2-3 cm) can reduce rhizoctonia hypocotyl rot disease
- Establishment tends to be uneven and weak when seed is sown below 7 cm.[12]

10 DPIRD website (2016) Lupin Essentials – growing a successful lupin crop, https://www.agric.wa.gov.au/lupins/lupin-essentials-%E2%80%93-growing-successful-lupin-crop

11 DPIRD website (2016) Lupin Essentials – growing a successful lupin crop, https://www.agric.wa.gov.au/lupins/lupin-essentials-%E2%80%93-growing-successful-lupin-crop

12 DPIRD website (2016) Lupin Essentials – growing a successful lupin crop, https://www.agric.wa.gov.au/lupins/lupin-essentials-%E2%80%93-growing-successful-lupin-crop

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MORE INFORMATION

Lupins.org: www.lupins.org

A.5.5 Inoculation

- Rhizobia are needed for nodulation and N fixation by lupin crops
- Inoculate seed with rhizobia when sowing lupin in a paddock for the first time
- Inoculate seed five years after the previous lupin crop on acid soils (pH below 6.5)
- Inoculate seed for every lupin crop on neutral and alkaline soils (pH above 6.5)
- Use a Group G or S inoculant.[13]

A.5.6 Weed control

- Effective weed control is essential for good yields
- Where practical, delay sowing to maximise weed kill from knockdown herbicides (especially where WA blue lupin is present)
- Incorporate pre-emergent simazine in wet soil if possible
- Ensure an even crop to optimise effectiveness of post-emergent herbicides
- Spray small weeds early
- Use highest registered rates of herbicides
- Crop-topping can be used when 80 percent of leaves have turned brown and/or fallen off lupin plants
- Implement cultural practices into integrated weed management plans
- Harvest weed seed capture and destruction can lower the weed seed bank.[14]

A.5.7 Insect control

- Check lupin crops for insects at critical development stages
- From emergence to three weeks, monitor Redlegged earth mites (*Halotydeus destructor*), cutworm (*Agrotis sp.*) and Lucerne flea (*Agrotis sp.*)
- At flowering, monitor aphids (*Aphididae*) and thrips (*Thysanoptera*)
- At pod fill, monitor native budworm (*Helicoverpa punctigera*)
- Adopt integrated pest management plans.[15]

A.5.8 Disease control

- Lupin roots, hypocotyls, stems, pods and seeds are susceptible to disease
- Manage with crop rotation, stubble retention, fungicide or pesticide application, variety selection and seed testing/treatment
- Reduce anthracnose risk by treating seed with a thiram-based seed dressing.[16]

A.5.9 Nutrition and fertiliser

- Use soil/plant tissue testing or paddock history to determine fertiliser rates
- Drill or band phosphate at seeding
- If needed, apply potassium within four weeks of sowing
- On potentially manganese (Mn)-deficient soils (mainly light sands), apply Mn super deep banded or as a spray when first pods are 2.5 cm.[17]

13 Pulse Australia website (2016) Pulses: Understanding Global Markets, http://www.pulseaus.com.au/growing-pulses/publications/marketing-pulses#lupin

14 DPIRD website (2016) Lupin Essentials – growing a successful lupin crop, https://www.agric.wa.gov.au/lupins/lupin-essentials-%E2%80%93-growing-successful-lupin-crop

15 DPIRD website (2016) Lupin Essentials – growing a successful lupin crop, https://www.agric.wa.gov.au/lupins/lupin-essentials-%E2%80%93-growing-successful-lupin-crop

16 DPIRD website (2016) Lupin Essentials – growing a successful lupin crop, https://www.agric.wa.gov.au/lupins/lupin-essentials-%E2%80%93-growing-successful-lupin-crop

17 Pulse Australia website (2016) Pulses: Understanding Global Markets, http://www.pulseaus.com.au/growing-pulses/publications/marketing-pulses#lupin

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A.5.10 Harvest

- Harvest lupin crops when ripe
- Delays can reduce yields from lodging, pod shattering/drop or cracked grain
- Start harvest when grain moisture content reaches 14 percent
- Harvest when humidity is high and temperatures not extreme
- Harvest as quickly as possible
- Set the harvester drum or rotor speed to a minimum
- Open the concave relatively wide
- Store any harvested grain at an average moisture content of 20 degrees Celsius.[18]

A.6 Keywords

Lupin, pulse, narrow leafed lupin, albus lupin, pearl lupin, yellow lupin, western region, crop rotations, nitrogen fixing

18 DPIRD website (2016) Lupin Essentials – growing a successful lupin crop, https://www.agric.wa.gov.au/lupins/lupin-essentials-%E2%80%93-growing-successful-lupin-crop