WESTERN
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GRDC GROWNOTES™

GRDC GRAINS RESEARCH & DEVELOPMENT CORPORATION

LUPIN

SECTION 1

PADDOCK PLANNING AND PREPARATION

CROP OVERVIEW | LUPIN VARIETIES IN THE WESTERN REGION | SOIL TYPES AND PADDOCK SELECTION | WEED AND HERBICIDE CONSIDERATIONS | DISEASE AND PEST CONSIDERATIONS | MACHINERY CONSIDERATIONS | SEED QUALITY AND GERMINATION ISSUES

MORE INFORMATION

DPIRD lupin hub: https://www.agric.wa.gov.au/lupins/lupin-western-australian-farming

GRDC Hot Topic 'Break crop research': https://grdc.com.au/Media-Centre/Hot-Topics/Break-crop-research

Planning/paddock preparation

1.1 Crop overview

Including lupin in crop rotations with cereals can be more profitable than continuous cereal production in parts of Western Australia.

Other benefits include providing a cereal disease and pest break, increasing supplies of organic soil nitrogen (N), opening up more options for weed control and providing livestock feed in mixed farming systems.

Lupin effectively fix atmospheric N in symbiosis with bacteria and can take up phosphorus (P) efficiently from the soil.

Trial data collected from across WA's grainbelt by the Department of Primary Industries and Regional Development (DPIRD) – formerly the Department of Agriculture and Food Western Australia (DAFWA) – since the 1960s shows that growing continuous wheat crops in this State is rarely as productive or economically viable as rotations that include break crops, such as lupin, or pasture.

The data shows that yields from wheat following lupin crops average 0.6 tonnes per hectare higher than wheat crops following wheat and this can be higher if there are limiting factors such as root diseases or take all.[1]

An analysis of 167 crop sequence trials in WA shows that wheat crops following fallow have an average 0.3 t/ha yield advantage over continuous wheat.[2] Recent research in WA is also finding that there are soil N and wheat yield benefits from including summer-sown serradella (and potentially biserrula, gland clover and bladder clover) in rotations, especially in medium to high rainfall areas and on acid soils.[3]

In the early years of the State's lupin industry, lupin-cereal rotations (with these crops grown in alternate years) were very common and are still practiced on some sandplain soils.

But in recent years, high canola prices have seen the oilseed replace lupin crops in many areas and, in some regions, cereal sequences have been extended.

Newer lupin varieties released for WA, including PBA Leeman$^{\Phi}$, PBA Jurien$^{\Phi}$ and PBA Barlock$^{\Phi}$, have superior tolerance to the herbicide metribuzin (a Group C triazinone) which opens-up a wider range of weed control options in this phase of the rotation than has been previously possible.

Common cereal diseases and pests, including take-all, crown rot, common root rot, Septoria, Yellow spot, Barley yellow dwarf virus, rusts, mildew, some Root lesion nematodes (RLN) and Cereal cyst nematode (CCN), are not hosted by lupin plants.

This means a wheat crop grown after lupin tends to be less affected by these diseases and pests than if grown after wheat.

Lupin crops require a large amount of N for growth and obtain most of this from the atmosphere through symbiotic N fixation with rhizobia.

1 Seymour, M, Kirkegaard, J, Peoples, M, White, P, French, R (2012) Break crop benefits to wheat in Western Australia – insights from over three decades of research, Crop and Pasture Science, http://www.publish.csiro.au/cp/CP11320

2 Seymour, M, Kirkegaard, J, Peoples, M, White, P, French, R (2012) Break crop benefits to wheat in Western Australia – insights from over three decades of research, Crop and Pasture Science, http://www.publish.csiro.au/cp/CP11320

3 Loi, A (2014) Summer serradella emerging as a viable legume option, Ground Cover Issue 113: Nov-Dec 2014, GRDC, https://grdc.com.au/Media-Centre/Ground-Cover/Ground-Cover-Issue-113-NovDec-2014/Summer-serradella-emerging-as-a-viable-legume-option

FEEDBACK

After the crop is harvested, some of this N remains behind in the paddock as decaying roots, fallen leaves and stubble and – over time – becomes available to subsequent crops.

Typically, the higher the lupin yield, the more N is retained in the paddock and this more than compensates for the amount of N exported in the lupin grain.

DPIRD modelling has shown a 1.5 t/ha lupin crop can add about 60 kilograms/ha of soil N. This would provide about 25 kg/ha of available N to the following crop, which is the N equivalent to 52 kg/ha of urea fertiliser and sufficient to produce about 0.5 t/ha of wheat.[4]

1.2 Lupin varieties in the western region

- Variety choice depends on farm location and disease risk
- Test seed for germination, vigour, seed size, disease presence
- Most recent WA narrow leafed varieties are PBA Leeman⟑, PBA Jurien⟑, PBA Barlock⟑ and PBA Gunyidi⟑
- Newest WA albus variety is Amira⟑
- Pearl lupin may have potential in WA in future.

There are predominantly two types of lupin produced across southern Australia, each with separate growth requirements and end-uses.

Australian sweet lupin, or narrow leafed lupin (*Lupinus angustifolius*), is the main species grown in WA, which is the nation's biggest lupin producing State.

It is highly suited to the acidic, sandy or low fertility soils of the western region, where other pulses may grow poorly.

The albus lupin (*L. albus*), or European white lupin, is grown across all three Australian grain growing regions, including parts of WA, but in much smaller areas.

Albus varieties are best suited to fertile, well-drained, medium to heavy soils and show slightly better adaptation than narrow leafed varieties to alkaline soils.

There are several other lupin species that have been considered for broadacre production in WA, including:

- » Blue (sandplain) – lupin (*L. cosentinii*) – limited use in some areas for summer grazing; a weed to grain growers
- » Yellow lupin (*L. luteus*) – trialed in WA, not grown extensively
- » Atlas lupin (*L. atlanticus*) – not grown commercially
- » Hairy lupin (*L. pilosus*) – not grown commercially
- » Pearl lupin (*L. mutabilis*) – being tested for adaptation in WA.

Australian narrow leafed and albus lupin varieties have been developed in national collaboration through Pulse Breeding Australia (PBA).

Key agronomic traits and disease resistance status of the varieties commonly grown in WA are outlined in Table 1.

MORE INFORMATION

Pulse Australia lupin variety information: www.grdc.com.au/Research-and-Development/Major-Initiatives/PBA/PBA-Varieties-and-Brochures

NVT Sowing guides: http://www.nvtonline.com.au/crop-guides/sa/

4 White, P, French, B, McLarty, A (2008) Producing Lupins. Department of Agriculture and Food WA Bulletin 1-2008, http://researchlibrary.agric.wa.gov.au/cgi/viewcontent.cgi?article=1009&context=bulletins

Table 1: Lupin variety agronomic and disease guide

Variety	Flowering time	Height	Lodging	Pod Shattering	Drought Tolerance	Aphid Resist	Brown Leaf Spot	Pleiochaeta root rot	CMV seed tranmit	Anthracnose	Phomopsis – Stem	Phomopsis – Pod
Narrow leafed												
Jenabillup	M	T	MR	MS	MR	MR	MRMS	R	MRMS	S	MS	R
Coromup	E					R	MS		R	MR	R	R
Mandelup	VE	T	MS	MS	MR	R	MS	R	MS	MR	R	MRMS
PBA Barlock	E	M	MR	R		R	MS		RMR	R	MR	R
PBA Gunyidi	VE	M	MS	R	MR	R	MS	R	MRMS	MR	R	R
PBA Jurien	VE	T	MS	MR		R	MS		MRMS	R	R	MR
PBA Leeman			MSMR	MR		R	MS		MRMS	MR	R	R
Wonga	E-M	M	MR	R	MS	R	MS	R	R	R	R	R
Albus lupin												
Amira	E	S-M	MR							MR		
Andromeda	M-L	M-T	MR							MS		

Flowering time; VE=very early, E=early, M=mid, L=late
Height; S=short, M=medium, T=tall
Lodging and disease reactions; R = Resistant RMR = Resistant to moderately resistant MR = Moderately resistant
MRMS = Moderately resistant to moderately susceptible MS = Moderately susceptible MSS = Moderately susceptible to susceptible
S = Susceptible SVS = Susceptible to very susceptible VS = Very susceptible.

(SOURCE: Agriculture Victoria: agriculture.vic.gov.au/__data/assets/word_doc/0009/318879/Lupin-2016.docx)

The agricultural areas of WA that are suited to lupin production are shown in Figure 1.

These have been split these into eight zones, each having broadly similar farming systems and production constraints that require similar management. Advisers can help to determine the parts of these zones that are more suited to lupin production than others and can recommend suitable lupin types and varieties for specific environmental and soil conditions.

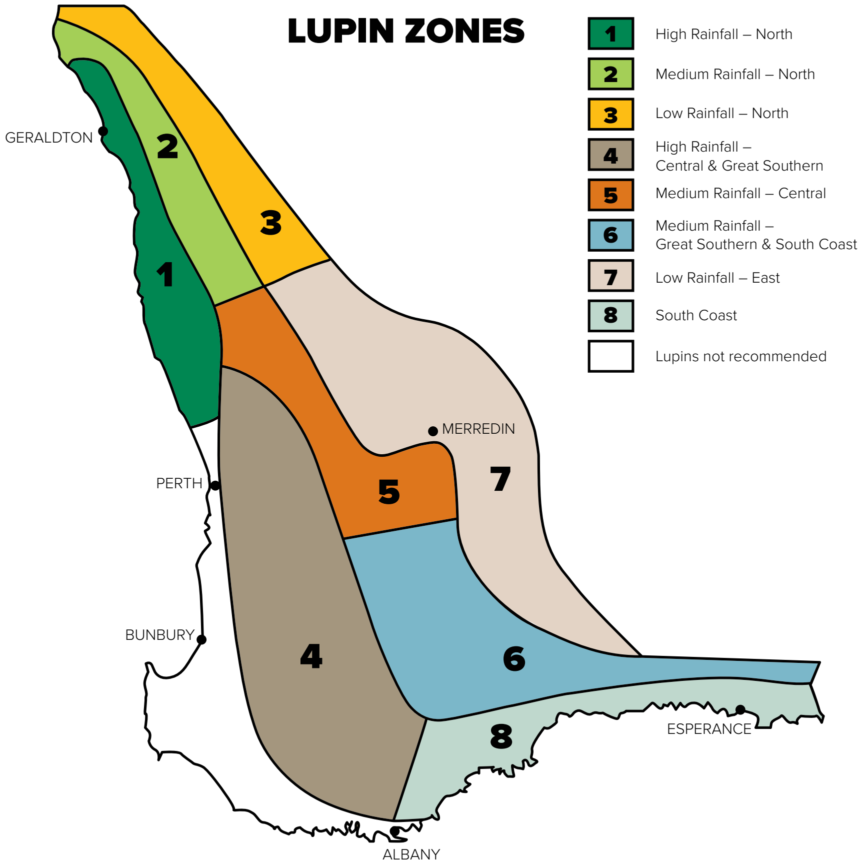

Figure 1: *Lupin production zones in Western Australia.*

(SOURCE: DAFWA)

MORE INFORMATION

GRDC PBA Leeman variety brochure: http://www.grdc.com.au/Research-and-Development/Major-Initiatives/PBA/PBA-Varieties-and-Brochures

1.2.1 Narrow leafed lupin varieties grown in WA

PBA Leeman

Figure 2: *The new variety PBA Leeman is high protein and expected to be available for planting in 2018.*

(SOURCE: PBA/GRDC)

- Bred by the PBA Lupin Breeding Program, led by DPIRD
- Released in September 2017 under PBA through Seednet
- Seed should be available for planting in 2018
- High protein – average 0.6 percent higher than Coromup⍉
- Good resistance levels to stem phomopsis and anthracnose
- Very tolerant to metribuzin
- Good pod shatter resistance – similar to PBA Gunyidi⍉ and better than Mandelup⍉
- Highly suited to AgZones 1, 2, 3, 5
- Updated yield data from 2016 trials to be released in 2017.

(SOURCE: Seednet)

FEEDBACK

MORE INFORMATION

GRDC outlines development of PBA Jurien⁽ᵈ⁾ at: https://grdc.com.au/Media-Centre/Ground-Cover/Ground-Cover-Issue-118-Sep-Oct-2015/Whats-new-in-pulses-for-planting-in-2016

PBA Jurien⁽ᵈ⁾

Figure 3: *The narrow leafed PBA Jurien⁽ᵈ⁾ is a recently released lupin variety in Australia.*

(SOURCE: GRDC)

- Released 2015
- High yielding in most regions of WA and Australia
- Touted as Mandelup⁽ᵈ⁾ replacement in WA
- Resistant to anthracnose (equivalent to PBA Barlock⁽ᵈ⁾)
- Resistant to phomopsis (equivalent to PBA Gunyidi⁽ᵈ⁾)
- Tolerant to metribuzin (superior to PBA Barlock⁽ᵈ⁾, similar to Coromup⁽ᵈ⁾)
- Early flowering
- Early maturing
- Seed size similar to Mandelup⁽ᵈ⁾
- Seed weight 10-17 g/100.

The narrow leafed PBA Jurien⁽ᵈ⁾ is one of the most recently released lupin varieties in Australia, originating from the PBA Lupin Breeding Program, led by DPIRD in WA and tested as WALAN2385.

It combines strong disease resistance (R) to anthracnose and phomopsis with superior yield potential over some current varieties in WA, including PBA Barlock⁽ᵈ⁾ and PBA Gunyidi⁽ᵈ⁾ – as shown in Table 2.

Table 2: 2014 Lupin variety yields (WA) – Adjusted trial yields expressed as % of the site mean

Lupin Zone	1	2	3	4	5	6	7	8	Overall
Coromup⁽ᵇ⁾	81	90	87	73	88	85	89	69	84
Danja⁽ᵇ⁾	81	98	80	77	84	81	91	73	85
Jenabillup⁽ᵇ⁾	102	94	98	95	101	96	98	100	98
Mandelup⁽ᵇ⁾	90	106	106	96	99	100	99	118	100
PBA Barlock⁽ᵇ⁾	110	105	88	108	102	106	110	91	105
PBA Gunyidi⁽ᵇ⁾	97	104	101	107	103	105	101	102	102
Tanjil⁽ᵇ⁾	95	99	85	88	91	94	96	92	94
PBA Jurien⁽ᵇ⁾	102	99	106	109	112	107	112	110	107
Site Mean	**2.73**	**1.91**	**1.24**	**2.5**	**1.91**	**3.08**	**0.73**	**2.67**	**1.96**

(SOURCE: Alan Meldrum, Pulse Australia 2014)[5]

PBA Jurien⁽ᵇ⁾ is a potential replacement for PBA Barlock⁽ᵇ⁾ in WA's AgZone 1 (high rainfall parts of the northern agricultural region) and for Mandelup⁽ᵇ⁾ in most other regions of this State.

This variety is moderately susceptible (MS) to brown leaf spot and fungicide seed dressings are recommended, especially to reduce risks of seed-borne anthracnose infection.

It is moderately resistant (MR) to Cucumber mosaic virus (CMV) and Bean yellow mosaic virus (BYMV).

Its agronomic traits are similar to PBA Gunyidi⁽ᵇ⁾ and flowering time is slightly earlier than for PBA Barlock⁽ᵇ⁾.

PBA Jurien⁽ᵇ⁾ has good metribuzin tolerance and tolerance to pod shattering at harvest, but there is a slight risk of lodging in high-yielding situations.

In terms of grain quality, it has medium-large seeds with an alkaloid content similar to PBA Gunyidi⁽ᵇ⁾ that will meet market requirements.[6]

5 Meldrum, Alan (2014) Pulse Variety Performance. Pulse Australia, https://grdc.com.au/Research-and-Development/GRDC-Update-Papers/2015/02/Pulse-Variety-Performance-in-2014

6 Pulse Breeding Australia (2016) PBA Varieties and brochures, www.grdc.com.au/Research-and-Development/Major-Initiatives/PBA/PBA-Varieties-and-Brochures

MORE INFORMATION

GRDC's Ground Cover looks at the merits of PBA Barlock⏀ at: https://grdc.com.au/Media-Centre/Ground-Cover/Ground-Cover-Issue-107-NovDec-2013/New-varieties-maintain-pulse-momentum

PBA Barlock⏀

Figure 4: *PBA Barlock⏀ is a high yielding variety in WA.*

(SOURCE: GRDC)

- Released 2013
- High yielding across WA
- Resistant to anthracnose
- Tolerant to metribuzin (equal to Mandelup⏀)
- Moderately resistant to phomopsis stem blight
- Improved resistance to pod shattering over Mandelup⏀
- Early to mid-flowering
- Early maturity.

PBA Barlock⏀ was tested in WA as WALAN2325 and is suitable to replace Mandelup⏀, Tanjil⏀ and Wonga in most lupin growing areas of WA.

It is particularly well adapted to the high and medium rainfall zones of the State's northern agricultural regions.

PBA variety trials have shown a 2-3 percent yield advantage over the traditionally popular variety Mandelup⏀ and up to 12 percent higher yields than Tanjil⏀ in most areas of WA. This is illustrated in the 2014 results shown in Table 2.

PBA Barlock⏀ has considerably more metribuzin tolerance than the older WA varieties, allowing more options for weed control in-crop.

Strong anthracnose resistance makes PBA Barlock⏀ the best variety choice in AgZone 1 and, in all regions, seed dressing is recommended to reduce risks of seed-borne infections.

This variety is MS to brown leaf spot, but MR to CMV seed transmission.

It has shown similar herbicide tolerance to Mandelup⏀ and has less risk of pod shattering at harvest. Seed size is similar to Tanjil⏀ and protein levels are similar to Mandelup⏀.[7]

7 Pulse Breeding Australia (2016) PBA Varieties and brochures, www.grdc.com.au/Research-and-Development/Major-Initiatives/PBA/PBA-Varieties-and-Brochures

PBA Gunyidi⫽

Figure 5: *PBA Gunyidi⫽ has good resistance to pod shattering.*

(SOURCE: GRDC)

- Released 2010
- Slightly later flowering and maturing than Mandelup⫽
- Shorter stem
- Resistant to phomopsis stem blight
- Moderately susceptible to brown leaf spot
- Moderately resistant to CMV seed transmission
- Moderately resistant-resistant to anthracnose
- High resistance to pod shattering
- Good lodging resistance.

PBA Gunyidi⫽ tends to be higher yielding than Mandelup⫽ in all WA lupin production zones.

As found in the PBA variety trial results from 2014, shown in Table 2, it has clear advantages in the AgZones 1, 4, 6 and 7.

This variety is early flowering and maturing, with high resistance to pod shattering at harvest, which reduces risks of yield loss if harvest is delayed.

PBA Gunyidi⫽ has good tolerance to commonly used herbicides, including metribuzin, and varied resistance levels to aphids, anthracnose and phomopsis stem blight. It is mildly susceptible to brown leaf spot.[8]

8 Pulse Breeding Australia (2016) PBA Varieties and brochures, www.grdc.com.au/Research-and-Development/Major-Initiatives/PBA/PBA-Varieties-and-Brochures

Jenabillup⁽ᵈ⁾

Figure 6: *Jenabillup is a good variety for WA's high rainfall areas.*

(SOURCE: GRDC)

- Released 2007
- Slightly later flowering than Mandelup⁽ᵈ⁾
- Moderately resistant to BYMV
- Less suited to crop-topping than Mandelup⁽ᵈ⁾
- Susceptible to anthracnose
- Less tolerant of metribuzin.

Jenabillup⁽ᵈ⁾ remains a good variety choice for lupin production in WA's high rainfall areas, especially in AgZone 8, due to its BYMV resistance levels (it is MR).

As shown in Table 2, it out-yielded PBA Barlock⁽ᵈ⁾ in 2014 variety trials in this zone. This variety is mid-maturing, which suits areas with a longer growing season, as the extended flowering window can assist with boosting yield. But this factor makes it less suitable for crop-topping.

Jenabillup⁽ᵈ⁾ is MR for black pod syndrome and brown leaf spot and MR for seed transfer of CMV.

Coromup⍁

Figure 7: *Coromup⍁ is an older variety released for WA's medium and low rainfall areas.*

(SOURCE: GRDC)

- Released 2006
- Aimed at WA medium and low rainfall zones
- High protein and grain quality
- Early maturing
- Good resistance to anthracnose and phomopsis stem blight
- Metribuzin tolerance similar to Mandelup⍁.

Coromup⍁ was released in 2006 as a high quality narrow leafed variety for WA's medium and lower rainfall zones, but has largely been replaced by newer lines.

It has high seed protein – 2.4 percent higher than Mandelup⍁ – and a good disease resistance and herbicide tolerance profile.

Coromup⍁ is early maturing but tends to be susceptible to lodging in high rainfall areas.

Mandelup⁽ᵇ⁾

Figure 8: *Mandelup has mostly been replaced in WA with newer varieties.*

(SOURCE: GRDC)

- Released 2005
- Good early vigour and harvest height
- Early flowering
- Suits heavy soil types
- High phomopsis resistance
- Anthracnose and aphid resistant
- Tolerant to metribuzin
- Good seed protein.

Mandelup⁽ᵇ⁾ is widely adapted and has been a consistently high yielding variety in many WA AgZones in recent years, but is now largely replaced by newer varieties.

Its early maturity makes it suitable for crop-topping for weed management and it has good metribuzin tolerance.

This variety is not recommended for high rainfall areas, as it has a tendency to lodge in high productivity.

It has also experienced problems with pod shatter if there is a delayed harvest and can have poorer seed germination rates than some other varieties in some years.

Quilinock⫯

Figure 9: *Qulinock⫯ has mostly been replaced in WA.*
(SOURCE: GRDC)

- Released 2001
- Suited to medium and low rainfall areas
- Some brown leaf spot resistance
- Moderate resistance to CMV
- Susceptible to anthracnose
- Prone to lodging in high rainfall areas.

At its release, Quilinock⫯ was suited to WA's central and eastern grainbelt, where risks of disease – such as anthracnose – and lodging are low.

This variety has largely been replaced by newer varieties in WA.

Tanjil⁽ᵈ⁾

Figure 10: *Tanjil is an older variety for WA with good anthracnose resistance.*
(SOURCE: GRDC)

- Released 1999
- Suited to high rainfall areas of WA's northern grainbelt
- Resistant to anthracnose
- Early maturing
- Low risk of lodging
- Sensitive to metribuzin.

Tanjil is an older variety that was well suited to the northern grainbelt, with good anthracnose resistance and higher yields than the Wonga variety.

It has resistance to stem and pod phomopsis and aphids, with MR to CMV. But it is sensitive to metribuzin.

Wonga

Figure 11: *Wonga is an older variety for WA that has mostly been replaced.*

(SOURCE: GRDC)

- Released 1998
- Early-mid flowering
- Moderately yielding
- Resistant to anthracnose and phomopsis
- Can be susceptible to brown leaf spot
- Sensitive to metribuzin.

Wonga is an early flowering, moderate yielding narrow leafed variety that is resistant to anthracnose and phomopsis.

It is suited to medium rainfall zones, but has largely been replaced by newer WA varieties. It does remains an option for disease and weed control in the lupin phase, but is sensitive to metribuzin.

MORE INFORMATION

DPIRD guide to growing Amira⁽ᵈ⁾: https://www.agric.wa.gov.au/lupins/amira-anthracnose-resistant-albus-lupin-western-australia?page=0%2C1

1.2.2 Albus (or European white) lupin varieties in WA

Amira⁽ᵈ⁾

Figure 12: *Amira is a new albus variety that is early flowering.*

(SOURCE: GRDC)

- High yielding
- Anthracnose resistant
- Mid-flowering, late maturing
- Similar grain size and quality to Andromeda⁽ᵈ⁾ and Kiev Mutant.

Amira⁽ᵈ⁾ was released in 2012 as a relatively early flowering variety that produces high yields in similar areas to where Kiev Mutant was popular before outbreaks of anthracnose in WA.

As indicated in Table 3, trials during the 2000s showed Amira⁽ᵈ⁾ consistently produced about 20 percent higher yields than Andromeda (released in 2005) and has been suggested as a replacement for that variety in WA.[9]

Table 3: Grain yield of Amira⁽ᵈ⁾ in relation to other albus lupin varieties from Western Australian variety trials (2007-2010)

Variety	2007	2008	2009	2010	Overall Mean
Amira⁽ᵈ⁾	117	147	114	124	126
Andromeda⁽ᵈ⁾	100	100	100	100	100
Kiev Mutant	106	137	133	113	122
No.of trials	2	2	2	1	

(SOURCE: DAFWA)[10]

Amira⁽ᵈ⁾ is well suited to medium rainfall areas of WA's northern grainbelt, where anthracnose pressure is not high

9 DPIRD (2016) Amira: an anthracnose resistant albus lupin for Western Australia, https://www.agric.wa.gov.au/lupins/amira-anthracnose-resistant-albus-lupin-western-australia?page=0%2C1

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

As shown in Table 4, Amira⫯ is MR to anthracnose and has significantly better resistance to this disease than Andromeda⫯, but crops may still require fungicide protection in high rainfall and high disease risk areas.[11]

Table 4: Phenology and anthracnose ratings of albus lupin varieties

Variety	Flowering time	Maturity time	Plant Height	Lodging	Anthracnose
Amira⫯	early	mid-early	short-med	MR	MR
Andromeda⫯	mid-late	late	med-tall	MR	MS
Kiev Mutant	early	early	medium	MS	VS

MR = moderately resistant, MS = moderately susceptible, S = susceptible
(SOURCE: DAFWA)[12]

Herbicide tolerance trials in WA on red clay loam and red sandy loam soils show Amira⫯ has good tolerance to herbicides commonly used in albus lupin production.

It has metribuzin tolerance similar to Andromeda⫯ and Kiev Mutant.

Amira⫯ is tolerant to aphids in WA conditions, but will be affected by native budworm (*Helicoverpa sp.*).

It is advised not to delay harvest for this variety, even though pods are unlikely to shatter or shed, to ensure seeds remain undamaged and are of high quality.

Amira⫯ has large white seed similar to Kiev Mutant and will be accepted in human consumption markets. Its seed alkaloid content is lower than Andromeda⫯ and protein content is similar to Kiev Mutant and Andromeda⫯.[13]

11 DPIRD (2016) Amira: an anthracnose resistant albus lupin for Western Australia, https://www.agric.wa.gov.au/lupins/amira-anthracnose-resistant-albus-lupin-western-australia?page=0%2C1

12 DPIRD (2016) Amira: an anthracnose resistant albus lupin for Western Australia, https://www.agric.wa.gov.au/lupins/amira-anthracnose-resistant-albus-lupin-western-australia?page=0%2C1

13 DPIRD (2016) Amira: an anthracnose resistant albus lupin for Western Australia, https://www.agric.wa.gov.au/lupins/amira-anthracnose-resistant-albus-lupin-western-australia?page=0%2C1

MORE INFORMATION

DPIRD guide to growing Andromeda⁽ᵇ: https://www.agric.wa.gov.au/lupins/growing-andromeda-%E2%80%93-albus-lupin-variety-improved-tolerance-anthracnose

Andromeda⁽ᵇ

Figure 13: *Andromeda⁽ᵇ suits medium rainfall areas of WA.*

(SOURCE: GRDC)

- Released 2005
- Improved tolerance to anthracnose than Kiev Mutant
- Suits medium rainfall areas
- Suits loams and red soils
- Later flowering.

Andromeda⁽ᵇ is no longer widely grown in WA, but was the first anthracnose resistant albus variety to be released (as a replacement for Kiev Mutant) in this State in the past decade.

It could produce higher yields under high anthracnose pressure, but was consistently about 10 percent lower yielding than Kiev Mutant when disease severity was low.

DPIRD advises that Andromeda⁽ᵇ remains suited to some areas receiving about 350-400 mm annual rainfall and responds well to early sowing because it is later flowering.

It is also well suited to the fertile loams or clay loams that occur in valleys throughout WA and the red soils of the Mingenew, Mullewa and Morawa region, but will not grow well in infertile sands or duplex soils.

Andromeda⁽ᵇ seed contains 39 percent protein and 9 percent oil, both higher than narrow leafed lupin seed and seed from other pulse crops.

It has a lower alkaloid and crude fibre content than narrow leafed lupin and could be a useful stockfeed.[14]

14 DAFWA (2016) Growing Andromeda – an albus lupin variety with improved tolerance to anthracnose, https://www.agric.wa.gov.au/lupins/growing-andromeda-%E2%80%93-albus-lupin-variety-improved-tolerance-anthracnose

Kiev Mutant

Figure 14: *Kiev Mutant was popular in WA in the 1990s but has been replaced with newer varieties.*

(SOURCE: GRDC)

- Released 1970s
- Redundant in WA.

Kiev Mutant was grown in WA's northern grainbelt and other parts of the State during the 1990s, but the variety disappeared when lupin anthracnose was identified in 1996. It was replaced by Andromeda$^{\phi}$ and, more recently, Amira$^{\phi}$.

1.2.3 Potential new lupin species for WA

Researchers have identified three alternative lupin species with potential for WA conditions:

- Atlas lupin (*Lupinus atlanticus*)
- Hairy lupin (*Lupinus pilosus*)
- Pearl lupin (*Lupinus mutabilis*).

Atlas and hairy lupin types belong to the same rough-seeded group as WA blue – or sandplain – lupin and are adapted to fine-textured alkaline soils.

DPIRD plant breeders have fully domesticated both of these species, but breeding efforts have now stopped and to 2016 there was no commercial production in this State.

DPIRD indicates that pearl lupin are of more interest because of the high grain protein and oil content of this species, which is similar to soybeans (up to 45 and 18 percent respectively) and higher than other domesticated lupin species.

Field trials of advanced breeding lines of sweet pearl lupin types have been undertaken in WA, where it is thought these varieties may have a place on fertile soils and in environments that suit albus lupin.

A small breeding program was conducted by DPIRD researcher Jon Clements.

As part of this research, he worked with DPIRD's Mark Sweetingham and their trials found that pearl lupin was acid tolerant, but did not perform well on the classic deep sandy soils where narrow leafed lupin grows well.[15]

Their research indicated the pearl lupin lines were slightly more susceptible to lime-induced iron deficiency than narrow leafed lupin.

Field trials showed pearl lupin was most competitive in yield with other lupin species in medium to higher yielding regions with low anthracnose risk, such as the southern grainbelt.

Even in these regions, yields tended to be significantly lower than narrow leafed and albus lupin. These lines were less tolerant of triazine herbicides and could potentially require more weed control consideration.[16]

Glasshouse trials have found current pearl lupin germplasm is very susceptible to brown leaf spot, quite susceptible to anthracnose, requires fungicide seed treatment and would need to be grown in wide rotations.[17]

15 DPIRD (2016) Potential new lupin species for Western Australian Agriculture, https://www.agric.wa.gov.au/lupins/potential-new-lupin-species-western-australian-agriculture

16 Clements, J, Buirchell, B, Francis, G, Sweetingham, M (2006) Higher yielding elite lines of pearl lupin for Australian agriculture, CLIMA, UWA, DAFWA, http://www.google.com.au/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0ahUKEwj_per02IvPAhXTQD4KHQR-CpMQFggbMAA&url=http%3A%2F%2Fuwa.edu.au%2F__data%2Fassets%2Fword_doc%2F0019%2F920431%2FHigher_yielding_elite_lines_of_pearl_lupin_for_Australian_agriculture_Summary2.doc&usg=AFQjCNGo-sQ1-4-onH_6FpdvXk7d_JMJyQ&sig2=jtcVR2bGuowOc2kdVeJz5g&bvm=bv.132479545,d.dGo

17 Sweetingham, M (2005) The potential of the pearl lupin (*Lupinus mutabilis*) for southern Australia, DAFWA, http://finalreports.grdc.com.au/UWA00043

FEEDBACK

MORE INFORMATION

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

1.3 Soil types and paddock selection

- Ideally sow in sandy textured soils with pH 4.5 – 7 (Calcium Chloride – $CaCl_2$) and good depth
- Avoid saline, waterlogging-prone, alkaline and shallow duplex soils
- Avoid soils with free lime or limestone
- Choose paddocks with a relatively low weed burden
- Avoid paddocks with big populations of WA blue lupin
- Ideally use paddocks with high stubble to reduce brown leaf spot risk
- Consider disease and weed burdens for rotation intervals.

Narrow leafed lupin varieties suit soils with low free lime levels (up to 4 percent) and will experience poor growth on hard setting or shallow soils (less than 25 cm) that prevent root penetration.

These varieties are most suited to acid soils with a pH of 4.5 – 7, formed with sand (or sand over clay) and well-structured loam soils.

Albus lupin is suited to medium to heavy, fertile and free-draining soils. These varieties are sensitive to waterlogging and grow poorly on sandy soils.

WA's newest albus variety, Amira⁽ᵈ⁾, yields well on the fertile loams or clay loams that occur in valleys right across the grainbelt and on the red soils of the Mingenew, Mullewa and Morawa region. It has not performed well in infertile sands or duplex soils.

Amira⁽ᵈ⁾ is adapted to soils of slightly higher pH than narrow leafed lupin, but will not grow well on loams and clays with a pH above 7.5 if these soils become saturated with water.

It is best to avoid, where possible, sowing albus lupin crops close to WA blue lupin infestations (such as along fence lines and in-paddock populations), as blue lupin can harbour anthracnose. Frost sensitivity can also be a problem in prone areas.[18]

MORE INFORMATION

WeedSmart 10-point plan: www.weedsmart.org.au

GRDC Integrated Weed Management hub: www.grdc.com.au/IWM

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

1.4 Weed and herbicide considerations

- Summer and in-season weed control is vital to optimise lupin crop yields
- Consider herbicide residues when choosing lupin paddocks
- Where practical, delay sowing to maximise weed kill from knockdown herbicides (particularly in the presence of WA blue lupin)
- Apply suitable pre or post-emergent herbicides
- Ensure an even crop for post-emergent herbicide applications at correct stage
- Spray small weeds early for an effective kill
- Use highest registered rates of post-emergent herbicides (without crop damage)
- Use desiccation and/or crop-topping later in the season if necessary
- Consider harvest weed seed capture and destruction to run down weed seedbanks.

Paddock preparation for lupin starts in the summer, as crop germination and early growth can be adversely affected where Afghan melons (*Cucumis myriocarpus*) and paddy melons (*Citrullus lanatus*) and other weeds are present.

Lupin can be impacted by herbicide residues where rainfall has been minimal in both summer and the previous growing season.

This should be a consideration when planning lupin paddocks and crop sequences, as should the weed burden that could be left-over from the previous year if knockdown has not been possible.

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

Consideration of the herbicide label for the active type and plant-back periods should be given, as well as soil pH and rainfall.

Lupin crops have particular sensitivity to group B sulfonamide residues and all pulses, including lupin, are vulnerable to some Group I residues.

An integrated weed management (IWM) plan that incorporates herbicide, cultural and physical measures will be most effective for supressing weeds, lowering weed seedbanks and prolonging herbicide sustainability in WA lupin crops.[19]

MORE INFORMATION

DPIRD Lupin essentials guide to paddock planning: https://www.agric.wa.gov.au/lupins/lupin-essentials-%E2%80%93-growing-successful-lupin-crop

1.5 Disease and pest considerations

- Test planting seed for presence and levels of anthracnose
- Use fungicide seed dressings where necessary
- If disease pressure high, use label rates of registered foliar fungicides
- Check crops from emergence to three-weeks for mites, cutworm and Lucerne flea
- Check for aphids at flowering
- Check for native budworm at pod fill.

Most modern narrow leafed and albus lupin varieties have reasonable disease resistance.

But it is recommended to have narrow leafed seed tested for CMV and anthracnose and albus seed tested for anthracnose.

Narrow leafed lupin is susceptible to Brown leaf spot and to avoid other viruses, sowing lupin adjacent to legumes or pastures is not recommended.

Most current varieties have phomopsis resistance, but significant rain on the plants while maturing or after harvest can prompt disease development.

Care should be taken if this occurs and there is intent to graze lupin stubbles or feed seed to stock. The aim is to avoid lupinosis in livestock in this situation.

If a paddock has a history of lupin disease, it may be best to rest or sow a different crop to allow for a disease 'break'.[20]

MORE INFORMATION

DPIRD machinery and harvest tips: https://www.agric.wa.gov.au/lupins/amira-anthracnose-resistant-albus-lupin-western-australia?page=0%2C2#smartpaging_toc_p2_s1_h3 and https://www.agric.wa.gov.au/lupins/lupin-essentials-%E2%80%93-growing-successful-lupin-crop?page=0%2C4#smartpaging_toc_p4_s2_h2

1.6 Machinery considerations

- Aim for narrow leafed and albus plant density of 40 – 45 plants/m^2
- This is a sowing rate of about 150 kg/ha for albus and 80-100 kg/ha for narrow leafed varieties
- Use sowing depth of 3-5 cm
- For albus, coarse metering wheels on air seeders can help avoid cracking the seed
- An agitator in the seed box can help albus seeds flow smoothly
- At harvest, set the harvester drum or rotor speed to a minimum and the concave opened quite wide
- For albus, harvest using wide wire concaves or remove alternate wires of a cereal concave
- Increase concave clearance if seed is being cracked
- Increase drum speed if seed is left in the pods
- Handle seed carefully after harvest to avoid damage.

The recommended plant density for narrow leafed and albus lupin crops in WA is 40 to 45 plants/m^2. This equates to a seeding rate of about 150 kg/ha for albus and 80-100 kg/ha for narrow leafed varieties.

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

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

WA trials have shown optimum plant densities that will maximise yields change depending on location and season, but losses can be substantial if plant populations fall below 40 plants/m^2.[21]

Research has found that keeping lupin crop density high helps to suppress weed growth, boost crop competitiveness with weeds, reduce Brown leaf spot and CMV effects and allows the crop to compensate for any issues with poor establishment due to sandblasting, non-wetting soils and/or root diseases.[22]

Successful lupin growing can often depend on equipment.

At seeding, augers have potential to damage grain and using tabulators – or belt elevators – may provide a possible solution.

Seeders need to be capable of sowing bigger lupin seed and modifications to seed tubes and dividing heads may be required, as well as the metering mechanisms.

At harvest, care is needed to avoid pod shattering as lupin grain enters the header from the cutter bar. This risk can be reduced by harvesting in high humidity and avoiding extreme heat.

For albus lupin, it is recommended to use wide wire concaves or remove alternate wires of a cereal concave because the seeds are large.

It is advised to start with the closest concave clearance and the slowest drum speed and then increase concave clearance if seed is being cracked.

Use higher drum speed if seed is left in the pods and carefully handle seed after harvest to avoid damage.

Machine cleaning may be necessary where there is evidence of certain diseases.[23]

1.7 Seed quality and germination issues

MORE INFORMATION

GRDC's Stored Grain information hub: http://storedgrain.com.au/

If using lupin seed from WA or South Australia (SA), it must be tested for anthracnose (which only occurs in these two states) to avoid spread.

Grain being retained from harvest for subsequent sowing should be harvested first, where possible, to ensure best quality and germination rates.

Ideally, moisture levels should be below 14 percent at harvest.

The lupin seed embryo is very sensitive to impact if it becomes dry and brittle.

Research has found that even seed with no visible damage can have low percentage germination rates if it suffered a high impact when its moisture content was low.

Seed with moisture levels above 13 percent should not be stored in a steel silo after harvest. It may be advisable to dry the grain to ensure viability.[24]

21 White, P, French, B, McLarty, A (2008) Producing Lupins. Department of Agriculture and Food WA Bulletin 1-2008, http://researchlibrary.agric.wa.gov.au/cgi/viewcontent.cgi?article=1009&context=bulletins

22 White, P, French, B, McLarty, A (2008) Producing Lupins. Department of Agriculture and Food WA Bulletin 1-2008, http://researchlibrary.agric.wa.gov.au/cgi/viewcontent.cgi?article=1009&context=bulletins

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

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