PULSE GUIDE

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INTRODUCTION

Pulses can be useful break crops to grow in rotation with cereals and canola. A well-managed pulse crop can reduce disease in following crops, control grass weed populations and fix nitrogen. Cereal yields and grain protein are usually maximised following a pulse, lupin or pasture legume. After a peak in the 1990s, pulse crop areas declined due to an expansion in canola area as well as difficulties with in-crop control of broadleaf weeds and diseases.

New varieties with improved herbicide tolerance and resistance to key pathogens are now available to address these challenges.

RELATIVE YIELD OF CROPS IN WA

TABLE 1 Yield of crops in NVT experiments conducted in the past six years in WA and break-even yield, based on a five-year average price.

Crop	NVT yields (t/ha)			Break even yield (t/ha)		
	Mean	Minimum	Maximum	Low rainfall	Medium rainfall	High rainfall
Barley – malt	3.4	0.3	6	0.8	1.4	1.7
Canola – TT	2	0.5	3.4	0.6	0.9	1.1
Chickpea	1.3	0.3	2.2	0.4	0.5	0.6
Faba bean	2.6	0.7	4	0.6	1	1.3
Field pea	1.6	0.4	2.9	0.7	0.9	1.2
Lentil	1.2	0.3	1.9	0.5	0.7	0.8
Lupin	2.1	0.3	4.1	0.7	0.9	1.1
Oat	3.3	0.8	6.1	0.8	1.3	1.7
Wheat	3	0.6	5.7	0.8	1.4	1.9

SOURCE: NVT 2013 TO 2018. PIRSA FARM GROSS MARGIN GUIDE 2018

PICKING A PULSE

TABLE 2 Adaptation of canola, pulses and lupin to some soil factors.

Crop	pH	Soil texture	Salinity tolerance rank	Boron tolerance rank	Comments
Canola	4 to 9	All	-	-	
Chickpea	5.2 to 9	Sandy loamy to clay	5	2 Kabuli 5 Desi types	
Faba bean	5.2 to 9	Loam-clay	1	1	Lower pH ok in higher rainfall areas
Field pea	5 to 9	Loamy sand to clay	2	2 dun varieties 4 white varieties	
Lentil	5.2 to 9	Loam-clay	4	6	Herbicide damage an issue on sandier soils
Lupin – narrow-leaf	4 to 7	Sand to sandy loam	3	-	
Lupin – albus	5.5 to 7.5	Loamy sand to loam	4	-	Higher pH than NLL
Vetch	5 to 9	Loamy sand to clay	2	1	

1 = Least sensitive, 5 = most sensitive

TABLE 3 Recent experiences and comments on broadleaf crops in WA.

Crop	Comments
Canola	• Hard to beat in WA. Well adapted to WA soils and climate plus excellent weed control. • Appears to be more sensitive to delayed sowing and patchy emergence than most pulse crops. • Consider alternative breaks to canola if nematodes are an issue.
Chickpea	• Due to lack of cold tolerance, best results in warmer areas – but high prices make them an option throughout WA. • Low weed burdens and a wider range of chemical options have improved weed control – but no viable crop-topping option = pick low-weed paddocks.
Faba bean	• Lower pH ok in higher rainfall areas. PBA Bendoc[1] x IMI herbicides increased interest. Very high prices in 2018 around $1000/t – better to use long-term price of $330/t. • Recent varieties x agronomy = lower disease risk.
Field pea	• Robust varieties and agronomy package. Best weed control package of the pulses. • Lack of early sowing option and higher forecast prices for other pulses put peas under pressure in the rotation.
Lentil	• Seek advice before growing lentils. • Wide range of grower experiences from very good yields to very poor results. • Herbicide damage an issue on sandier soils. • Can be sown in April in frost-free areas.
Lupin – narrow-leaf	• Canola being the first sown crop in the rotation has reduced the pressure on lupin.
Lupin – albus	• Best suited to medium rainfall areas of the northern wheatbelt. • Adapted to loams with pH 6.0 or above. Early sowing critical to ensure ok flowering window. Avoid paddocks with blue lupins due to anthracnose. Niche markets, investigate marketing.
Vetch	• Particularly suited to farmers with livestock. • Species available that can be sown very early and grazed multiple times. • Grain vetch growers need to talk to marketers as the demand for grain can be variable.

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TABLE 4 Fungicides for pulse crops in WA.

Active ingredient		carbendazim (500g/L)	chlorothalonil (720g/L)	chlorothalonil (900g/kg)	mancozeb (750g/kg)	procymidone (500g/L)	prothioconazole (150g/L) + bixafen (75g/L)	tebuconazole (430g/L)	tebuconazole (200g/L) + azoxystrobin (120g/L)
Example product		Spin Flo®	Bravo® Weather Stik® Barrack Betterstick® Nufarm Unite® 720	Sipcam Echo® 900 WDG (Fungicide)	Dithane™ Rainshield™ Neo Tec™	Fortress® 500 Sumitomo Sumisclex® 500	Aviator® Xpro®	Orius® 430 SC	Veritas®
Crop	**Disease**								
Chickpea	Ascochyta blight		1.0–2.0L	0.8–1.6kg	1.0–2.2kg		400–600mL		0.75–1.0L
	Botrytis grey mould	500mL			1.0–2.2kg				0.75–1.0L
	Sclerotinia								
Field pea	Blackspot		1.1–1.8L		1.0–2.2kg		600mL		
	Downy mildew/BGM		1.1–1.8L	0.9–1.5kg	1.0–2.2kg				0.75–1.0L
	Powdery mildew							145mL	
Faba bean	Ascochyta				1.0–2.2kg		400–600 mL		0.75–1.0L
	Cercospora				1.0–2.2kg		400–600 mL	145mL#	300mL
	Chocolate spot	500mL	1.4–2.3L	1.2–1.9kg	1.0–2.2kg	500 mL	600 mL		0.75–1.0L
	Rust		1.4–2.3L	1.2–1.9kg	1.0–2.2kg		600 mL	145mL#	300mL
Lentil	Ascochyta blight		1.0–2.0L	0.8–1.6kg	1.0–2.2kg		400–600 mL		0.75–1.0L
	Botrytis grey mould	500mL	1.0–2.0L	0.8–1.6kg	1.0–2.2kg	500 mL	400–600 mL		0.75–1.0L
	Sclerotinia								
Lupin	Anthracnose				1.0–2.2kg				
	Sclerotinia								
Vetch	Ascochyta blight				1.0–2.2kg				
	Botrytis grey mould	500mL			1.0–2.2kg				0.75–1.0L
	Rust				1.0–2.2kg				
WHP harvest		28 days	14 days	14 days	28 days	Faba bean 9 days, lentil 21 days	Not required	3 days	28 days
WHP graze		28 days	14 days	14 days	14 days	Lentil 21 days	35 days	3 days	28 days
Group		Group 1	Group M5	Group M5	Group M3	Group 2	Group 3 and 7	Group 3	Group 3 and 11
Special comments					Less effective on botrytis grey mould and chocolate spot than alternative products		DO NOT apply after early flowering in faba, field pea and lentil or after late flowering in chickpea		

WHP=withholding period # refer to permit PER13752

LUPIN

INTRODUCTION

Lupins are uniquely suited to the acid and sandy soils found across large tracts of the Western Australian wheatbelt and play an important role in breaking cereal disease cycles and adding fixed nitrogen to cropping systems.

Increased use of canola as a break crop in recent years has seen lupin production in Western Australia decline from a high of more than one million hectares in the late 1990s to about 300,000 to 400,000 hectares with a current gross value of production of around $200 million.

WHAT IS NEW?

In September 2019 a new variety of narrow-leaf lupin was released called Coyote[Φ]. It is early maturing (similar to Jurien[Φ]), with metribuzin tolerance similar to Mandelup[Φ]. Coyote[Φ] is moderately susceptible to phomopsis; graze lupin stubbles with care in high-risk environments.

WHAT VARIETY SHOULD I GROW?

Besides looking for stable high yields, growers generally chose to grow varieties with sufficient metribuzin tolerance for broadleaf weed control as well as anthracnose tolerance and low pod shatter. In recent years, the most widely grown varieties have been PBA Jurien[Φ] and Mandelup[Φ].

Please refer to Figure 2 on outside back cover for the lupin Agzone key, which has eight zones compared with six for the other major crops.

TABLE 1 Grain yield of narrow-leaf lupin varieties in Agzone 1 expressed as a percentage of site mean yield for each trial year (2014–18).

Year		2014	2015	2016	2017	2018
Site mean yield (t/ha)		2.94	3.90	3.12	1.64	2.18
	No. of trials	(2)	(3)	(4)	(3)	(4)
Coromup[Φ]	(16)	92	96	102	97	114
Coyote[Φ]	(16)	104	109	106	121	126
Jenabillup[Φ]	(16)	99	97	93	93	116
Mandelup[Φ]	(12)	89	104	107	110	-
PBA Barlock[Φ]	(12)	107	105	118	102	-
PBA Bateman[Φ]	(3)	105	107	102	-	118
PBA Gunyidi[Φ]	(12)	104	104	105	109	-
PBA Jurien[Φ]	(12)	107	110	128	111	-
PBA Leeman[Φ]	(13)	88	99	96	-	121
Tanjil[Φ]	(12)	94	96	95	95	-

SOURCE: NVT ONLINE, NVTONLINE.COM.AU

NOTE: For all Agzones in 2018, Mandelup[Φ], PBA Barlock[Φ], PBA Gunyidi[Φ] and PBA Jurien[Φ] establishment was poor and these varieties were not included in analysis. Use 2018 data with caution.

TABLE 2 Grain yield of narrow-leaf lupin varieties in Agzone 2 expressed as a percentage of site mean yield for each trial year (2014, 2015 and 2018).

Year		2014	2015	2018
Site mean yield (t/ha)		1.91	2.59	3.21
	No. of trials	(2)	(2)	(1)
Coromup(ф)	(5)	96	97	123
Coyote(ф)	(5)	103	105	137
Jenabillup(ф)	(5)	98	96	126
Mandelup(ф)	(4)	101	99	-
PBA Barlock(ф)	(4)	100	109	-
PBA Bateman(ф)	(5)	101	104	128
PBA Gunyidi(ф)	(4)	101	104	-
PBA Jurien(ф)	(4)	102	113	-
PBA Leeman(ф)	(5)	100	96	130
Tanjil(ф)	(4)	98	96	-

SOURCE: NVT ONLINE, NVTONLINE.COM.AU

NOTE: For all Agzones in 2018, Mandelup(ф), PBA Barlock(ф), PBA Gunyidi(ф) and PBA Jurien(ф) establishment was poor and these varieties were not included in analysis. Use 2018 data with caution.

TABLE 3 Grain yield of narrow-leaf lupin varieties in Agzone 3 expressed as a percentage of site mean yield for each trial year (2014–18).

Year		2014	2015	2016	2017	2018
Site mean yield (t/ha)		1.24	2.34	2.57	1.90	1.95
	No. of trials	(1)	(1)	(1)	(1)	(1)
Coromup(ф)	(5)	90	103	111	104	96
Coyote(ф)	(5)	112	101	94	115	117
Jenabillup(ф)	(5)	99	98	93	101	110
Mandelup(ф)	(4)	110	107	107	101	-
PBA Barlock(ф)	(4)	102	101	118	105	-
PBA Bateman(ф)	(4)	108	99	91	-	113
PBA Gunyidi(ф)	(4)	103	100	100	107	-
PBA Jurien(ф)	(4)	107	104	126	107	-
PBA Leeman(ф)	(4)	99	105	97	-	106
Tanjil(ф)	(4)	92	101	101	95	-

SOURCE: NVT ONLINE, NVTONLINE.COM.AU

NOTE: For all Agzones in 2018, Mandelup(ф), PBA Barlock(ф), PBA Gunyidi(ф) and PBA Jurien(ф) establishment was poor and these varieties were not included in analysis. Use 2018 data with caution.

TABLE 4 Grain yield of narrow-leaf lupin varieties in Agzone 4 expressed as a percentage of site mean yield for each trial year (2014–18).

Year		2014	2015	2017	2018
Site mean yield (t/ha)		1.79	1.20	2.76	2.40
	No. of trials	(2)	(2)	(2)	(1)
Coromup(ф)	(7)	91	99	98	107
Coyote(ф)	(7)	135	126	107	125
Jenabillup(ф)	(7)	114	107	95	108
Mandelup(ф)	(6)	90	113	89	-
PBA Barlock(ф)	(6)	108	105	106	-
PBA Bateman(ф)	(5)	142	125	-	124
PBA Gunyidi(ф)	(6)	114	107	106	-
PBA Jurien(ф)	(6)	104	109	108	-
PBA Leeman(ф)	(5)	85	100	-	108
Tanjil(ф)	(6)	80	88	98	-

SOURCE: NVT ONLINE, NVTONLINE.COM.AU

NOTE: For all Agzones in 2018, Mandelup(ф), PBA Barlock(ф), PBA Gunyidi(ф) and PBA Jurien(ф) establishment was poor and these varieties were not included in analysis. Use 2018 data with caution.

TABLE 5 Grain yield of narrow-leaf lupin varieties in Agzone 5 expressed as a percentage of site mean yield for each trial year (2014–18).

Year		2014	2015	2016	2017	2018
Site mean yield (t/ha)		1.91	2.00	2.52	1.73	1.97
	No. of trials	(2)	(3)	(2)	(3)	(3)
Coromup(ф)	(13)	88	101	95	102	133
Coyote(ф)	(13)	106	111	116	127	139
Jenabillup(ф)	(13)	99	101	97	97	128
Mandelup(ф)	(10)	97	107	100	111	-
PBA Barlock(ф)	(10)	101	107	107	105	-
PBA Bateman(ф)	(10)	105	110	115	-	131
PBA Gunyidi(ф)	(10)	103	104	108	111	-
PBA Jurien(ф)	(10)	102	110	112	113	-
PBA Leeman(ф)	(10)	93	98	98	-	128
Tanjil(ф)	(10)	94	94	93	93	-

SOURCE: NVT ONLINE, NVTONLINE.COM.AU

NOTE: For all Agzones in 2018, Mandelup(ф), PBA Barlock(ф), PBA Gunyidi(ф) and PBA Jurien(ф) establishment was poor and these varieties were not included in analysis. Use 2018 data with caution.

TABLE 6 Grain yield of narrow-leaf lupin varieties in Agzone 6 expressed as a percentage of site mean yield for each trial year (2014–17).

Year		2014	2015	2016	2017
Site mean yield (t/ha)		3.08	2.14	0.89	3.02
	No. of trials	(1)	(1)	(1)	(1)
Coromup(ф)	(4)	90	97	98	91
Coyote(ф)	(4)	105	110	109	100
Jenabillup(ф)	(4)	96	100	88	94
Mandelup(ф)	(4)	101	108	111	96
PBA Barlock(ф)	(4)	104	104	114	97
PBA Bateman(ф)	(3)	103	107	102	-
PBA Gunyidi(ф)	(4)	103	103	105	101
PBA Jurien(ф)	(4)	107	107	126	98
PBA Leeman(ф)	(3)	96	99	102	-
Tanjil(ф)	(4)	95	94	96	101

SOURCE: NVT ONLINE, NVTONLINE.COM.AU

NOTE: For all Agzones in 2018, Mandelup(ф), PBA Barlock(ф), PBA Gunyidi(ф) and PBA Jurien(ф) establishment was poor and these varieties were not included in analysis. Use 2018 data with caution.

TABLE 7 Grain yield of narrow-leaf lupin varieties in Agzone 7 expressed as a percentage of site mean yield for each trial year (2014–18).

Year		2014	2015	2016	2017	2018
Site mean yield (t/ha)		0.89	1.09	1.80	0.33	1.74
	No. of trials	(2)	(2)	(3)	(1)	(2)
Coromup(ф)	(10)	89	94	96	187	116
Coyote(ф)	(10)	104	115	105	94	128
Jenabillup(ф)	(9)	98	99	95	117	112
Mandelup(ф)	(8)	97	115	105	101	-
PBA Barlock(ф)	(8)	104	106	110	118	-
PBA Bateman(ф)	(7)	102	111	102	-	119
PBA Gunyidi(ф)	(8)	102	104	103	101	-
PBA Jurien(ф)	(8)	106	112	116	116	-
PBA Leeman(ф)	(7)	93	100	96	-	122
Tanjil(ф)	(8)	95	92	95	118	-

SOURCE: NVT ONLINE, NVTONLINE.COM.AU

NOTE: For all Agzones in 2018, Mandelup(ф), PBA Barlock(ф), PBA Gunyidi(ф) and PBA Jurien(ф) establishment was poor and these varieties were not included in analysis. Use 2018 data with caution.

TABLE 8 Grain yield of narrow-leaf lupin varieties in Agzone 8 expressed as a percentage of site mean yield for each trial year (2014, 2017 and 2018).

Year		2014	2017	2018
Site mean yield (t/ha)		2.68	1.85	1.13
	No. of trials	(1)	(1)	(1)
Coromup[Ф]	(3)	87	89	70
Coyote[Ф]	(3)	108	124	146
Jenabillup[Ф]	(3)	89	103	89
Mandelup[Ф]	(2)	110	117	-
PBA Barlock[Ф]	(2)	106	96	-
PBA Bateman[Ф]	(2)	101	-	151
PBA Gunyidi[Ф]	(2)	104	105	-
PBA Jurien[Ф]	(2)	115	99	-
PBA Leeman[Ф]	(1)	101	-	-
Tanjil[Ф]	(2)	95	90	-

SOURCE: NVT ONLINE, NVTONLINE.COM.AU

NOTE: For all Agzones in 2018, Mandelup[Ф], PBA Barlock[Ф], PBA Gunyidi[Ф] and PBA Jurien[Ф] establishment was poor and these varieties were not included in analysis. Use 2018 data with caution.

TABLE 9 Lupin variety disease, insect and lodging rating.

Variety	Lodging (high rainfall)	Brown spot	Phomposis (stem)	Anthracnose	Grey spot	CMV (seed)	BYMV	Aphid
Coromup[Ф]	MRMS	MS	R	MR	R	MR	MS	R
Coyote[Ф]	-	MS	MS	MR	R	MR	MRMS	-
Jenabillup[Ф]	MRMS	MRMS	MS	MS	R	MS	MR	R
Mandelup[Ф]	MS	MS	R	MR	R	MS	S	R
PBA Barlock[Ф]	MR	MS	MR	R	R	MR	MS	R
PBA Bateman[Ф]	MRMS	MS	MR	MRMS	R	MR	MR	R
PBA Gunyidi[Ф]	MR	MS	R	MR	S	MR	MS	R
PBA Jurien[Ф]	MRMS	MS	R	R	R	MS	MR	R
PBA Leeman[Ф]	MRMS	MS	R	MRMS	R	MS	MS	R
Tanjil[Ф]	MR	MS	R	R	R	R	MS	R

R=resistant, MR=moderately resistant, MS=moderately susceptible, S=susceptible

SOURCE: PULSE BREEDING AUSTRALIA (PBA) TRIALS PROGRAM 2008–14, NVT AND AGT DATA

TABLE 10 Seed quality of narrow-leaf lupin varieties.

Variety	100 seed weight (g)*	Protein as % of Mandelup[Ф]	Alkaloid as % of Mandelup[Ф]
Coromup[Ф]	14.5	-	-
Coyote[Ф]	14.7	Similar to Mandelup[Ф]	Similar to Mandelup[Ф] and PBA Jurien[Ф]
Jenabillup[Ф]	15.6	103	67
PBA Barlock[Ф]	13.9	97	115
PBA Bateman[Ф]	15	-	-
PBA Gunyidi[Ф]	13.3	102	100
PBA Jurien[Ф]	14.7	102	105
PBA Leeman[Ф]	15	-	-
Tanjil[Ф]	13.3	100	113
Mandelup[Ф]	**14.7**	**32%**	**0.017**

SOURCE: * NVT; PROTEIN AND ALKALOID – % AS RECEIVED, WHOLE SEED, 6 SITES, 2010–14. CHEMCENTRE, BENTLEY, WA STANDARD PROTEIN AND ALKALOID ANALYSIS FOR NARROW-LEAF LUPIN

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LUPIN AGRONOMY GUIDE

Paddock selection

- Sandy textured soils with pH 4.5-7.0 (calcium chloride – $CaCl_2$) and good depth.
- Avoid saline soils, those subject to waterlogging, alkaline and shallow duplex soils.
- A relatively low weed burden.
- Avoid paddocks with large areas of WA blue lupins, particularly in the northern area.
- Ideally, paddocks with good stubble from previous year to reduce brown spot risk.
- The interval between lupin crops is determined by several factors including the risk of brown spot disease and weed burden.
- Soils must be free of sulfonylurea herbicide residues (e.g. Glean®, Logran®).

Rotation

- Growing lupins following a cereal crop minimises disease risk.
- Lupins should never be grown following lupins.

Sowing window

Agzone	Rainfall	Suggested sowing date
Agzone 1	High	Late April to early June
Agzone 2	Medium	Late April to mid May
Agzone 3	Low	Mid April to early May
Agzone 4	High	Early May to early June
Agzone 5	Medium	Late April to mid May
Agzone 6	Medium	Late April to mid May
Agzone 7	Low	Mid April to early May
Agzone 8	Medium	Late April to early June

Sowing depth

- Sow seeds 3–5cm below the soil surface.

Seed dressing and inoculation

- Seed should be treated with either iprodione (for example, Rovral®) or procymidone (for example, Sumisclex®) to reduce the risk of brown spot and pleiochaeta root rot on old lupin country.
- Thiram seed dressing should be applied to reduce the transmission of seed-borne anthracnose at the rate of 100g active ingredient per 100kg of seed. Thiram is not compatible with rhizobium inoculums.
- Apply Group G (or S) inoculum to seed or as dry granule where lupins have not been grown during the past five years. On neutral and alkaline soils inoculate every time a lupin crop is grown.

Fertiliser

- Use soil tests and paddock history to determine rates.
- Deep band phosphate at seeding for maximum efficiency and to minimise salt toxicity to seedlings.
- On potentially manganese-deficient soils, manganese can be drilled with compound fertiliser or alternatively applied as a foliar spray. This is especially important on paddocks growing next year's lupin seed.

Target density

- 40–45 plants/m^2.
- Yields can decline below 40 plants per square metre.

Seeding rate

- Between 90–120kg/ha – adjust for germination rate and seed size.

Seed source

- Use high-quality seed from paddocks with good fertiliser history.
- Check the seed for germination percentage, seed size, freedom from cucumber mosaic virus (CMV) and anthracnose. Use seed that has less than 0.5 per cent CMV-infected seed.
- In areas where manganese deficiency is a problem also test for manganese levels. Replace seed if manganese is below 20mg/kg.

Row spacing

- In the warm, dry environments of the medium and low-rainfall northern wheatbelt wider rows (50cm or more) are likely to yield better than narrow rows (18–25cm).
- Significantly, there is no yield penalty going wider.
- Narrower rows are most likely to yield better in cooler longer season environments where terminal drought is not severe and yield potential is very high.

Herbicide options

The following herbicides are registered on lupins in WA. It is advised to check labels of specific herbicide products for rates, crop and weed growth stages for application, recommended surfactants and oils, withholding and plant-back periods, etc.

Pre-emergent herbicides

- Atrazine 900g/kg (e.g. Atradex® WG) at 280–560g/ha
- Dimethenamid-P 720g/L (e.g. Outlook®) at 1L/ha
- Diuron 900g/kg (e.g. Diurex® WG) at 1.1kg/ha
- Pendimethalin 440g/L (e.g. Stomp®) at 1.5–2.25L/ha
- Propyzamide 900g/kg (e.g. Imtrade Edge® 900 WG) at 0.56–1.11kg/ha
- Prosulfocarb 800g/L + s-metolachlor 120g/L (e.g. Boxer Gold®) at 2.5L/ha
- Pyroxasulfone 850g/kg (e.g. Sakura®) at 118g/ha
- Simazine 900g/kg WG at 0.55–1.6kg/ha
- Terbuthylazine 875g/kg (e.g. Terbyne® Xtreme®) at 0.86–1.2kg/ha
- Tri-allate 500g/L (e.g. Avadex® Xtra) at 1.6L/ha
- Trifluralin 480g/L (e.g. TriflurX®) at 1.2–1.7L/ha
- Trifluralin 350g/L + Tri-allate 550g/L (e.g. Jetti Duo®) at 1.45–1.8L/ha

Important points to consider when using pre-emergent herbicides

- Soil type will influence the maximum rate of pre-emergent herbicides that can be applied; check the herbicide labels for details. For example, in Western Australia, simazine (900g a.i./kg) at 0.55–1.1kg/ha is registered on light soils, whereas 1.1–1.6kg/ha is registered for use on gravelly loam soils.
- Do not apply simazine, atrazine and diuron on deep white or grey sands.
- Due to a different subgroup within Group C herbicides, addition of 0.55–1.1kg/ha of diuron (900g a.i./kg) will assist in management of wild radish resistant to simazine/atrazine. It will also improve the control of capeweed and doublegee. Crop damage may occur if diuron is added to high rates of simazine or/and atrazine or terbuthylazine. For improved crop safety reduce the rate of triazines (e.g. simazine).
- If grass weed populations are high, add grass herbicides such as trifluralin, propyzamide, pyroxasulfone, etc, to the recommended rates of simazine/atrazine/terbuthylazine.
- Use of soil-applied residual herbicides on mouldboard ploughed/renovated soils could cause crop damage especially when lupins are sown shallower than the recommended depth of 3–5cm.

Post-emergent herbicides

Herbicides for broadleaf weed control

- Diflufenican 500g/L (e.g. Brodal® Options, Bonanza® Elite) at 100-200mL/ha
- Metosulam 100g/L (e.g. Eclipse®) at 50–70mL/ha
- Metribuzin 750g/kg (e.g. Stacato®, Mentor® WG) at 100–150g/ha plus 100mL/ha Broadal® (diflufenican 500g/L)
- Picolinafen 750g/kg (e.g. Conquest Glocker 750 WG Herbicide, Sniper®) at 33–50g/ha
- Simazine 900g/kg (e.g. Simagranz®) at 0.4–1.1kg/ha as a top-up application following a pre-emergence application of Simazine

Herbicides for grass weed control

- Butroxydim 250g/kg (e.g. Factor® WG) at 80–180g/ha
- Clethodim 240g/L (e.g. Select®, Status®) at 150–500mL/ha
- Diclofop-methyl 375g/L (e.g. Rhino®) at 1–2L/ha
- Fluazifop-p 128g/L (e.g. Fusilade® Forte) at 410–820mL/ha
- Haloxyfop-R 520g/L (e.g. Verdict®) at 50–100mL/ha
- Propaquizafop 100g/L (e.g. Shogun®) at 200–450mL/ha
- Quizalofop-p-ethyl 200g/L (e.g. Elantra® Xtreme®, Leopard® 200) at 65–190mL/ha
- Sethoxydim 186g/L (e.g. Sertin®) at 0.5–1L/ha

Post-emergent herbicides' timing for weeds

- Spray small weeds early.
- Apply top-up simazine, diflufenican and picinolinafen when radish has 2–6 leaves.
- Target radish smaller than 250mm in diameter with metribuzin.
- Use Eclipse® for controlling radish around 200mm in diameter or eight-leaf stage.
- Target ryegrass before tillering.

Important points to consider when using post-emergent herbicides

- High uptake of pre-emergent triazines (e.g. simazine or atrazine) following good soil moisture or high usage rates may predispose the lupin crop to damage by typically 'safe rates' of post-emergent broadleaf herbicides. Symptoms may include leaf whitening or root rot.
- Diflufenican (e.g. Brodal®) and picolinafen (e.g. Sniper®) alone, or in combination with other herbicides, cause bleaching/leaf spotting on most of the lupin varieties. Symptoms typically outgrow with time.
- The use of metribuzin alone, or in combination with other herbicides, may cause leaf burn and slight crop suppression in most varieties. Maximum rate of metribuzin 750 registered for post-emergent use on lupins is 112.5g a.i./ha from four leaves until bud emergence. Newer lupin varieties such as PBA Gunyidi$^{\Phi}$, PBA Barlock$^{\Phi}$, PBA Leeman$^{\Phi}$ and Coyote$^{\Phi}$ have better metribuzin tolerance than older varieties such as Tanjil$^{\Phi}$.
- It is advised not to apply metribuzin in mixture with other herbicides if brown leaf spot or other leaf diseases are present.
- Metosulam (e.g. Eclipse®) often causes yellowing, height and/or biomass reduction in most of the lupin varieties. Plants typically recover rapidly in typical growing conditions. It is advised not to use oils and wetters with metosulam and to apply only on healthy crops from eight leaves to the visible bud stage.
- Broadleaf herbicides should not be mixed with oil or products containing emulsifying agents.
- Application of broadleaf post-emergent herbicides to moisture-stressed lupins, or at the likely onset of moisture stress soon after application, can lead to crop damage from herbicides that are typically 'safe' when used in typical growing conditions.
- All grass-selective herbicides at label rates are typically safe when used on lupins, but it is advised not to apply such products in a tank mix with the broadleaf herbicides as crop damage will result.
- Ensure at least a 10-day break between spraying broadleaf herbicides and a grass-selective herbicide.

Crop-topping

- Paraquat 250g/L (e.g. Gramoxone®) is registered for crop-topping at 400 or 800mL/ha for ground application only.
- Crop-top when 80 per cent of leaves have fallen off the lupin plants and ryegrass should be at flowering to soft dough stage for best results.
- If the target lupin and ryegrass windows are not going to match up and weed control is your highest priority then you may need to consider sacrificing some lupin yield (which could be more than 25 per cent) and spray before 80 per cent leaf drop.
- The higher label rate may also increase any yield reduction. Do not harvest within seven days of application.

Desiccation

- Diquat 200g/L (e.g. Reglone®) is registered at 2-3L/ha as a pre-harvest desiccant at full crop maturity. It helps overcome slow and uneven ripening and weed problems at harvest.
- Saflufenacil 700g/kg (e.g. Sharpen® WG) is registered as a harvest-aid at 34g/ha in mixture with label rate of paraquat plus 1% Hasten or high quality methylated seed oil (MSO) of the spray volume. Apply when 80 per cent of lupin leaves have dropped off. Early applications than the recommended growth stage may result in grain yield penalties. Do not harvest within seven days of application.

Insect control

- Emergence – three weeks post-emergence: red legged earth mite, cutworm and lucerne flea
- Flowering: aphids
- Pod fill: native budworm

Aphid threshold

- Consider controlling aphids in flowering lupins if more than 30 per cent of the crop is infested.

Native budworm threshold

- Consider controlling budworm in lupins if more than eight budworm over 15mm are found in one square metre of crop (10 sweeps using a sweep net is about one square metre).

Disease management

- Lupins are susceptible to a wide range of diseases. Roots, hypocotyls, stems, pods and seeds are all subject to infection by disease organisms. Several of these diseases have the capacity to cause catastrophic losses, but this is rare if management guidelines are followed.
- Key steps in the integrated management of lupin diseases include crop rotation, stubble management, fungicide or pesticide application, variety selection and seed testing.
- On old lupin country seed should be treated with either iprodione (for example, Rovral®) or procymidone (for example, Sumisclex® Broadacre Fungicide) to reduce the risk of brown spot and pleiochaeta root rot.
- Where possible, choose seed with low risk of anthracnose or CMV infection. To reduce the transmission of seed-borne anthracnose seed should be treated with thiram seed dressing at the rate of 100–120g active ingredient per 100kg of seed. Thiram is not compatible with rhizobium inoculums.

Harvesting

- Harvest lupin crops as soon as they are ripe. Delays can result in significant loss of yield due to lodging, pod shattering and pod drop. Start harvesting as soon as the moisture content reaches 14 per cent. In some seasons this will occur when the stems are still pale green.
- Harvest losses can be substantially reduced by harvesting when humidity is high. Lupin plants strip well during the night and early morning; if possible, do not harvest in the middle of the day when it is very hot. In cooler southern environments, daytime temperatures often do not become warm enough to cause major problems for harvest.
- In these areas it may be better to harvest the crop as quickly as possible rather than swapping between lupins and cereals. Take special care when harvesting seed for next year's crop. Harvest it as soon as it is mature. Set the harvester drum or rotor speed to a minimum and the concave opened fairly wide.

  This will reduce damage to the embryo and help to ensure a high germination percentage. The seed embryo is very sensitive to impact if it becomes dry and brittle. Even seed with no visible damage may have low percentage germination if it suffered a high impact when its moisture content was low.

CHICKPEA

INTRODUCTION

Chickpea is a suitable break crop for heavier soils with pH above 5.5.

There was an expanding chickpea industry in WA during the 1990s until the arrival of Ascochyta blight. Since then, new varieties with tolerance to Ascochyta have been available and robust fungicide packages have been developed.

New herbicides have also become available for extended control of wild radish.

In recent years prices have been high, enticing some growers to start planting chickpeas again. However, prices remain somewhat volatile.

For trouble-free chickpea growing, ensure you select a variety with tolerance to Ascochyta, have a disease management plan, use an inoculant at sowing and sow into a relatively clean paddock as post-emergent broadleaf herbicides can be ineffective. It is important to use good seed; growers have been caught out not knowing the germination rate of chickpeas, resulting in very poor establishment.

WHAT TYPE AND VARIETY OF CHICKPEA SHOULD I GROW?

Western Australian growers have traditionally chosen to plant desi chickpea types as they have been higher yielding and easier to market than kabuli types. Desi chickpea types have small angular seeds weighing about 120mg, are wrinkled at the beak, and range in colour from brown to light brown and fawn. They are normally dehulled and split to obtain dhal. Kabuli types have larger, rounder seeds that are white-cream in colour and are almost exclusively used whole – so seed size and appearance are critically important. Yields of kabulis are generally lower and more variable than desi varieties, although premiums for larger chickpeas can offset the yield disadvantage.

Regardless of what type you choose to grow it is a good idea to talk to potential buyers before sowing.

Desi varieties

PBA Striker$^{\Phi}$ and Neelam$^{\Phi}$ are the most consistent performers across WA.

Kabuli varieties

Genesis 090 is the most readily available variety of kabuli in WA. It can command a premium price to varieties such as Genesis 079, but there is no guarantee that WA growers will be able to produce the required seed size in all years.

Chickpea seed size guide

TABLE 1 Chickpea seed size guide.

	Grade	Seed diameter	100 seed weight	Varieties
Desi type	Small		12–18	Gen508–510
	Medium		16–27	PBA Striker$^{\Phi}$, Gen836, Neelam$^{\Phi}$
Kabuli type	Small	6–8	20–35	Gen090, Gen079
	Medium	7–9	35–45	Almaz, PBA Monarch$^{\Phi}$
	Large	8–10	40–50	Kalkee
	Very large	9–11	50–65	Kimberley Large

SOURCE: AUSTRALIAN PULSE VARIETY GUIDE 2016 (PULSE AUSTRALIA)

Grain yield

TABLE 2 Grain yield of chickpea varieties (and year of release) in Agzone 1 expressed as a percentage of site mean yield for each trial year (2014–18).

Year		2014	2015	2016	2017	2018
Site mean yield (t/ha)		0.8	1.6	1.54	0.64	1.37
	No. of trials	(1)	(3)	(2)	(3)	(3)
DESI TYPE						
Ambar(Φ) (2013)	(12)	111	95	106	97	102
Genesis 836 (2006)	(12)	98	91	96	96	99
Neelam(Φ) (2013)	(12)	114	110	112	103	105
PBA Maiden(Φ) (2013)	(12)	97	93	102	101	103
PBA Slasher(Φ) (2009)	(12)	106	105	107	103	104
PBA Striker(Φ) (2012)	(12)	100	103	112	111	111
KABULI TYPE						
Genesis 090 (2005)	(12)	110	116	113	108	106

SOURCE: NVT ONLINE, NVTONLINE.COM.AU

TABLE 3 Grain yield of chickpea varieties in Agzone 2 expressed as a percentage of site mean yield for each trial year (2014–17).

Year		2014	2015	2016	2017
Site mean yield (t/ha)		0.95	1.27	0.97	1.00
	No. of trials	(3)	(2)	(1)	(1)
DESI TYPE					
Ambar(Φ)	(7)	102	96	110	104
Genesis 836	(7)	95	94	101	100
Neelam(Φ)	(7)	113	105	111	103
PBA Maiden(Φ)	(7)	105	100	109	103
PBA Slasher(Φ)	(7)	110	104	109	103
PBA Striker(Φ)	(7)	110	112	112	107
KABULI TYPE					
Genesis 090	(7)	113	112	107	103

SOURCE: NVT ONLINE, NVTONLINE.COM.AU

TABLE 4 Grain yield of chickpea varieties in Agzone 3.

Year		2017
Site mean yield (t/ha)		1.86
	No. of trials	(1)
DESI TYPE		
Ambar(Φ)	(1)	94
Genesis 836	(1)	98
Neelam(Φ)	(1)	100
PBA Maiden(Φ)	(1)	104
PBA Slasher(Φ)	(1)	103
PBA Striker(Φ)	(1)	106
KABULI TYPE		
Genesis 090	(1)	102

SOURCE: NVT ONLINE, NVTONLINE.COM.AU

TABLE 5 Grain yield of chickpea varieties in Agzone 4 expressed as a percentage of site mean yield for each trial year (2014–18).

Year		2014	2015	2016	2017	2018
Site mean yield (t/ha)		0.62	1.45	1.82	0.59	0.93
	No. of trials	(1)	(2)	(1)	(2)	(1)
DESI TYPE						
Ambar(Φ)	(7)	118	100	113	96	105
Genesis 836	(7)	107	95	98	93	101
Neelam(Φ)	(7)	102	106	118	105	104
PBA Maiden(Φ)	(7)	100	94	111	88	101
PBA Slasher(Φ)	(7)	96	101	113	99	102
PBA Striker(Φ)	(7)	120	101	125	106	99
KABULI TYPE						
Genesis 090	(6)	104	109	-	114	101

SOURCE: NVT ONLINE, NVTONLINE.COM.AU

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Disease ratings for selected chickpea varieties

TABLE 6 Disease resistance ratings for chickpea varieties.

	Ascochyta blight			Phytophthora root rot	Root lesion nematodes	
	Northern region	Southern region	Seed		*Pratylenchus thornei*	*Pratylenchus neglectus*
DESI TYPE						
Ambar(Φ)	MRMS	S	S	VS	MS	MRMS
Genesis 836	S	S	S	VS	-	-
Neelam(Φ)	MRMS	MS	S	VS	MS	MRMS
PBA Maiden(Φ)	MS	S	S	VS	MRMS	MRMS
PBA Slasher(Φ)	MRMS	S	S	VS	MRMS	MRMS
PBA Striker(Φ)	MS	S	S	VS	-	MRMS
KABULI TYPE						
Genesis 090	MR	MS	S	VS	MS	MRMS

R=resistant, MR=moderately resistant, MS=moderately susceptible, S=susceptible
The aggressive southern strain of Ascochyta has not been found in WA.

Variety traits

TABLE 7 Chickpea 100 seed weight (g) 2016–18.

Region	Agzone 1	Agzone 2	Agzone 4
No. of trials	(5)	(5)	(5)
DESI TYPE			
Ambar(Φ)	17	15	18
Neelam(Φ)	16	15	18
PBA Maiden(Φ)	20	18	21
PBA Slasher(Φ)	16	16	18
PBA Striker(Φ)	20	19	20
KABULI TYPE			
Genesis 090	22	23	22

SOURCE: NVT ONLINE, NVTONLINE.COM.AU

TABLE 8 Desi chickpea variety traits.

Variety	Plant height (cm)		Maturity	Lodging resistance
	Mingenew NVT 2019	Merredin NVT 2019		
Ambar(Φ)	-	-	Early	VG
Neelam(Φ)	48	33	Mid	VG
PBA Maiden(Φ)	43	30	Mid	M
PBA Slasher(Φ)	45	31	Mid	M
PBA Striker(Φ)	46	31	Early	M

SOURCE: NSW DPI WINTER CROP VARIETY SOWING GUIDE (2019), MERREDIN AND MINGENEW NVT TRIALS SEPT 2019

CHICKPEA AGRONOMY GUIDE

Paddock selection

- Well-drained loamy sands to clay loams with a pH above 5.5 ($CaCl_2$).
- No sulfonylurea or Lontrel® herbicide residues.
- A low broadleaf weed burden.
- Few rocks and roots so paddock can be left relatively flat and even after sowing.

Rotation

- One in four years.
- Avoid chickpea, faba, vetch, lentil or narbon bean stubble – at least 500 metres away from last year's stubble.

Sowing window

Agzone	Rainfall	Suggested sowing date	
		Desi	Kabuli
Agzone 1	Medium	25 April to 31 May	20 April to 20 May
	High	1 May to 31 May	25 April to 31 May
Agzone 2	Medium	25 April to 31 May	20 April to 20 May
	High	1 May to 31 May	25 April to 31 May
Agzone 3	High	25 April to 31 May	25 April to 31 May
Agzone 4	Low	25 April to 25 May	Not recommended*
Agzone 5	Low	25 April to 25 May	Not recommended
	Medium	1 May to 31 May	20 April to 20 May
Agzone 6	High	25 April to 31 May. Consider spring sowing to reduce disease risk	25 April to 31 May. Consider spring sowing to reduce disease risk

* Not generally recommended because failure to meet seed size requirement (>8mm) results in loss of kabuli premium price. A market for small seed kabuli (>7mm) does command a premium above desi types.

Sowing depth

- Aim for 5cm.
- Can be sown deeper to chase moisture

Seed dressing and rhizobia

- P-Pickel T, let dry then apply Group N inoculum or use granular products such as ALOSCA at 10kg/ha.

Fertiliser

- It takes approximately eight units of phosphorous to grow a chickpea crop that yields one tonne.
- If soil P levels are between 10mg/kg and 20mg/kg add at least 8kgP/ha. May be applied with compounds containing N (MAP, DAP, Agras etc.) or as single superphosphate.

Target density

- Desi – 40–45 plants/m^2
- Kabuli – 30–35 plants/m^2

Recommended plant density provides better competition with weeds than lower densities and aids efficient harvest.

Seeding rate

- Desi between 90–110kg/ha.
- Kabuli between 130-150kg/ha. Reduce in early sown high rainfall crops to reduce disease.

Calculate your own seeding rate as seed size and germination vary considerably. Stored chickpea seed can lose viability – always know the germination rate of your chickpea seed.

Row spacing

- Up to 50cm appears to have little effect on yield.
- Wider than 50cm will require specialist equipment for inter-row spraying.

Herbicide options

The following herbicides are registered on chickpea in WA. It is advised to check labels of specific herbicide products for rates, crop and weed growth stages for application, recommended surfactants and oils, withholding and plant-back periods, etc.

Pre-seeding and incorporated by sowing

- Cyanazine 900g/kg (e.g. Bladex®) at 1.1kg/ha
- Dimethenamid-P 720g/L (e.g. Outlook®) at 1L/ha
- Diuron 900g/kg (e.g. Diurex® WG, not all brands) at 0.83-1.1kg/ha
- Flumioxazin 500g/kg (Terrain®) at 180g/ha
- Pendimethalin 440g/L (e.g. Stomp®) at 1.5–2.25L/ha
- Propyzamide 900g/kg (e.g. Imtrade Edge® 900 WG) at 0.56–1.11kg/ha
- Prosulfocarb 800g/L + s-metolachlor 120g/L (e.g. Boxer Gold®) at 2.5L/ha
- Pyroxasulfone 850g/kg (e.g. Sakura®) at 118g/ha
- Simazine 900g/kg WG at 0.55–1.1kg/ha
- Terbuthylazine 875g/kg (e.g. Terbyne® Xtreme®) at 0.86-1.2kg/ha
- Terbuthylazine 750g/kg + isoxaflutole 75g/kg (e.g. Palmero® TX) at 1kg/ha

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- Tri-allate 500g/L (e.g. Avadex® Xtra) at 1.6L/ha
- Trifluralin 480g/L (e.g. TriflurX®) at 1.25–1.7L/ha plus 1.1kg/ha Simazine 900 DF
- Trifluralin 350g/L + Tri-allate 550g/L (e.g. Jetti Duo®) at 1.45-1.8L/ha

Post-sowing pre-emergent

- Diuron 900g/kg (e.g. Diurex® WG, not all brands) at 550–830g/ha
- Isoxaflutole 750g/kg (e.g. Balance®, Palmero®) at 100g/ha
- Metribuzin 750g/kg (e.g. Stacato®) at 180–380g/ha
- Simazine 900g/kg WG at 0.55–1.1kg/ha
- Terbuthylazine 875g/kg (e.g. Terbyne® Xtreme®) at 0.6–0.86kg/ha
- Terbuthylazine 750g/kg + isoxaflutole 75g/kg (e.g. Palmero® TX) at 0.7–1kg/ha

Post-emergent – for broadleaf weeds

- Flumetsulam 800g/kg (e.g. Broadstrike®) at 25g/ha

Post-emergent – for grass weeds

- Butroxydim 250g/kg (e.g. Factor® WG) at 80–180g/ha
- Clethodim 240g/L (e.g. Select®, Status®) at 150–500mL/ha
- Fluazifop-p 128g/L (e.g. Fusilade® Forte) at 500mL/ha
- Haloxyfop-R 520g/L (e.g. Verdict®) at 50–100mL/ha
- Propaquizafop 100g/L (e.g. Shogun®) at 200–450mL/ha
- Quizalofop-p-ethyl 200g/L (e.g. Elantra® Xtreme®, Leopard® 200) at 65–190mL/ha
- Sethoxydim 186g/L (e.g. Sertin®) at 0.5–1L/ha

Budworm threshold – very low

- Desi 1 caterpillar per 10 sweeps
- Kabuli 1 caterpillar per 20 sweeps

Disease management

Ascochyta blight is the most significant disease affecting chickpea crops in WA. Botrytis grey mould (BGM) can be a problem on kabuli grown in higher rainfall regions in the Geraldton Port Zone.

Pre-seeding

- Apply P-Pickel T seed dressing. This gives about four weeks of protection after which the requirement for foliar fungicide application should be assessed.

Post emergence fungicide options

- Apply chlorothalonil 720g/L product (1.0–2.0L/ha) or mancozeb 750g/kg product (1.0–2.0kg/ha) fungicides at four and seven weeks after emergence, then monitor regularly for disease. If disease is detected apply fungicide at three-week intervals before rain fronts.
- Veritas® fungicide (200g/L tebuconazole, 120g/L azoxystrobin) is registered for control of Ascochyta blight and botrytis grey mould in chickpea crops at an application rate of 0.75–1.0L/ha.
- Aviator® Xpro® foliar fungicide (bixafen 75g/L, prothioconazole 150g/L) is registered for control of Ascochyta blight in chickpeas at an application rate of 400–600mL/ha.
- Visit Pulse Australia website to find latest fungicide product information – http://www.pulseaus.com.au/growing-pulses/crop-protection-products

Desiccation

- Can be used as a harvest aid.
- Diquat 200g/L (e.g. Reglone®) at 2 to 3L/ha. Spray as soon as the crop has reached full maturity. It helps overcome slow and uneven ripening and weed problems at harvest. Do not harvest for two days after application.
- Glyphosate 690g/kg (e.g. Roundup Ready® herbicide with PLANTSHIELD®) at 530 to 1400g/ha. Apply when physiologically mature and less than 15 per cent green pod. DO NOT harvest within seven days of application. Use higher label rates where crops or weeds are dense and where faster desiccation is required.
- Saflufenacil 700g/kg (e.g. Sharpen® WG) 34g/ha in mixture with recommended label rate of glyphosate or paraquat plus 1% Hasten or high quality methylated seed oil (MSO) of the spray volume. Apply when 80 to 85 per cent of chickpea pods within crop have turned yellow-brown. Early applications than the recommended growth stage may result in grain yield losses. Do not harvest within seven days of application.

Harvesting

- Reel speed 1.0 x ground speed.
- Table auger 10–20mm.
- Drum or rotor speed 300–600rpm.
- Concave clearance 10–25mm (start at clearance 10mm).
- Fan speed 75–100 per cent (start at 100 per cent).
- Top sieve 16–25mm (start at 25mm) Bottom sieve 8–16mm (start at 16mm).

FABA BEAN

INTRODUCTION

Faba bean is best grown in medium and high-rainfall areas on medium-to-heavy textured soils where it has the highest yield potential of all pulse crops. It is best suited to early sowing in April. Unlike most pulses, beans can tolerate transient waterlogging and mild frosts, but they are particularly sensitive to dry conditions.

New bean cultivars have superior disease resistance to those widely grown in the 1990s. Combined with advances in fungicide and spray technology, the risk of the epidemics seen in the late 1990s are much lower nowadays.

WHAT IS NEW?

PBA Bendoc$^{\Phi}$ was released in 2018 as the first faba bean line with improved tolerance to imidazolinone (IMI) herbicides and the residues of some Group B herbicides including some sulfonylureas. The herbicide Intercept® (containing imazamox and imazapyr) plus other registered products have a minor use permit for use on imidazolinone-tolerant faba bean varieties such as PBA Bendoc$^{\Phi}$ (Permit 8684) until 30 April 2022.

PBA Bendoc$^{\Phi}$ has a small-to-medium sized seed (640mg) suited to the Middle East markets. It has lower disease resistance ratings for Ascochyta and Chocolate spot than the most widely grown bean variety PBA Samira$^{\Phi}$. There are seed bulkups occurring in WA in 2019 and seed is available from Seednet with an EPR of $3.90/t.

PBA Marne$^{\Phi}$ was also released in 2018. It is an early flowering line with potential for lower rainfall regions. Seed is available from Seednet with an EPR of $3.50/t.

Released in 2019, PBA Amberley$^{\Phi}$ is a mid-season flowering faba bean that has high yield potential in higher rainfall and long growing season districts. It has a greater level of resistance to Chocolate spot than all current varieties and is also resistant to both pathotypes 1 and 2 of Ascochyta blight. The improved disease resistance of PBA Amberley$^{\Phi}$ offers the potential to reduce the risk and cost of faba bean production in high rainfall areas where foliar fungal diseases are a major constraint. In limited trials in WA, PBA Amberley$^{\Phi}$ yields have been comparable to PBA Samira$^{\Phi}$. An end point royalty (EPR) of $3.85 per tonne (GST inclusive), which includes breeder royalty, applies upon delivery of this variety. Seed is available from Seednet.

WHAT VARIETY SHOULD I GROW?

PBA Samira$^{\Phi}$ is considered the benchmark variety for WA, and is the most widely grown variety. Growers who will benefit from using an IMI-tolerant variety should try PBA Bendoc$^{\Phi}$ – but they must also be prepared to have a robust fungicide program as PBA Bendoc$^{\Phi}$ has slightly lower disease ratings than PBA Samira$^{\Phi}$. Although PBA Warda$^{\Phi}$ and PBA Nasma$^{\Phi}$ had high yields in the 2018 trials they are quite susceptible to Ascochyta and should not be grown in southern regions as it is likely seed will be stained and downgraded.

Grain yield of faba bean varieties

TABLE 1 Grain yield of faba bean varieties in Agzone 3 and Agzone 5 expressed as a per cent of site mean yield for each trial year (2016–18).

Agzone	Agzone 3		Agzone 5			
Year		2017		2016	2017	2018
Site mean yield (t/ha)		0.70		3.82	1.40	3.09
	No. of trials	(2)	No. of trials	(2)	(2)	(2)
Farah(Φ)	(2)	95	(6)	94	105	97
Fiesta VF	-	-	(2)	-	-	96
Nura(Φ)	(2)	109	(6)	92	89	95
PBA Bendoc(Φ)	(2)	103	(6)	98	109	97
PBA Marne(Φ)	(2)	115	(6)	107	88	104
PBA Nasma(Φ)	-	-	(2)	-	-	107
PBA Rana(Φ)	(2)	82	(6)	88	98	95
PBA Samira(Φ)	(2)	92	(6)	99	106	99
PBA Warda(Φ)	-	-	(2)	-	-	107
PBA Zahra(Φ)	(2)	99	(6)	99	104	99

SOURCE: NVT ONLINE, NVTONLINE.COM.AU

Faba bean variety characteristics

TABLE 2 Faba bean agronomy characteristics

Variety	Seed grade	Seed size (mg, mean and range)	Seed colour	Plant height	Flowering time	Maturity	Lodging
Farah(Φ)	Medium	690 (590–760)	Light brown-brown	Medium	Early-mid	Early-mid	MS
Fiesta VF	Medium	690 (570–780)	Light brown-brown	Medium	Early-mid	Early-mid	MS
Nura(Φ)	Small-med	680 (550–790)	Light buff	Short	Mid	Early-mid	MR
PBA Bendoc(Φ)	Medium	640 (500–720)	Light brown	Medium	Mid	Early-mid	MS
PBA Marne(Φ)	Medium	740 (610–870)	Light brown	Medium	Early-mid	Early-mid	MR
PBA Rana(Φ)	Med-large	750 (650–900)	Light brown	Med/tall	Mid	Mid	MR
PBA Samira(Φ)	Medium	740 (580–870)	Light brown	Medium	Mid	Mid	MR
PBA Zahra(Φ)	Med-large	740 (620–860)	Light brown	Med/tall	Mid	Mid-late	MR

TABLE 3 Faba bean variety disease ratings.

Variety	Chocolate spot	Ascochyta blight		Rust	Cercospora leaf spot	PSbMV seed stain	Nematode resistance	
		Pathotype 1	Pathotype 2				*Pratylenchus thornei*	*Pratylenchus neglectus*
Cairo	VS	S	S	MS	S	-	S	-
Doza(Φ)	MS	S	S	RMR	S	-	S	MR
Farah(Φ)	S	RMR	S	S	S	S	MS	MR
Fiesta VF	S	MS	S	S	S	S	MS	MR
Nura(Φ)	MS	RMR	RMR	MS	S	VS	MS	MR
PBA Bendoc(Φ)	S	RMR	RMR	S	S	S	MS	MR
PBA Marne(Φ)	S	RMR	MRMS	MR	S	MR	MS	MR
PBA Nanu(Φ)	-	-	S	RMR	S	-	MR	-
PBA Nasma(Φ)	MS	S	S	RMR	S	-	S	MR
PBA Rana(Φ)	MS	R	MRMS	MS	S	MR	MS	MR
PBA Samira(Φ)	MS	RMR	RMR	MS	S	S	MRMS	MR
PBA Warda(Φ)	MS	S	S	RMR	S	-	MS	MR
PBA Zahra(Φ)	MS	R	MRMS	MS	S	S	MS	MR

R=resistant, MR=moderately resistant, MS=moderately susceptible, S=susceptible
PSbMV = pea seedborne mosaic virus

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FABA BEAN AGRONOMY GUIDE

Rotation

- Faba bean fixes large amounts of N, providing large rotation benefits for following crops.
- Grow no more often than one year in four in the same paddock to reduce disease risk. Avoid close rotations with vetch, narbon bean or lentil because some foliar diseases are common between these species.
- Retained cereal stubble can minimise the impact of a dry/hot spring, reduce aphids and lower disease spore splash.

Characteristics

- Vigorous early growth.
- Tolerates transient waterlogging and frosts better than most grain legumes.
- Early flowering, avoids spring drought, but dry and hot weather at flowering can reduce yields

Paddock selection

- Most suited to fine-textured or duplex soils, neutral to alkaline with a surface pH of 5.4–8.0 (in $CaCl_2$). Soils with a surface pH of 5–6 need to be more alkaline (pH >6) at depth (>20cm). In high-rainfall southern areas (e.g. Esperance sandplain) beans can be grown on lower pH sandy duplex paddocks, but will benefit from double the normal rate of rhizobia inoculation.
- Soils must be free of sulfonylurea herbicide residues (e.g. Glean®, Logran®), clopyralid residues (Lontrel®) and high exchangeable sodium.
- Paddocks need to have a low broadleaf weed and herbicide resistant ryegrass burden.
- Sow different faba bean varieties at least 500m away from each other to prevent cross-pollination.

Sowing time

High-rainfall areas (>450mm)

- 15 May to 7 June.
- In higher rainfall areas, early sowing can predispose the crop to disease.

Medium-rainfall areas (350–450mm)

- 15 April to 30 May.

Low rainfall areas (<350mm)

- 15 April to 15 May.
- Faba bean is not well suited to lower-rainfall areas in most years, especially in lighter soils. If sowing in these areas, early sowing is important.

Dry seeding is possible but not preferred due to poor rhizobia survival.

Sowing rate

- Aim to establish 25–30plants/m^2. Sow at 150–200kg/ha depending on seed size and germination percentage.
- Reduced sowing rates may be beneficial in high-yielding situations. Seed size can vary markedly between varieties and larger seed may require different seeding set up to prevent blockages. Minor modifications may include modifying the metering mechanism, seed tubes or dividing heads on air seeders.
- Seed should be tested for germination and vigour, with a minimum germination requirement of 70 per cent.

Sowing depth

- 5–8cm (2–3 inches).
- Can be sown at 8–10cm.

Inoculation

- Seed should be inoculated with Group F rhizobia using a peat or liquid slurry, or liquid or granules in furrow.
- If using a slurry, inoculate at least 24 hours after applying fungicidal seed treatment and seed within 12 hours.
- Double the recommended rates if the soils are not optimal for faba bean (pH less than 6.0, sandy).
- Avoid putting rhizobia down the same tube as acidic fertiliser, as it will kill the rhizobia.

Fertiliser

- 100–200kg/ha superphosphate, depending on soil test.
- Trace elements as for cereals.
- Excessive N application at sowing is unnecessary as it will restrict nodulation and reduce N-fixation.

Weed control

The following herbicides are registered on faba bean in WA. It is advised to check labels of specific herbicide products for rates, crop and weed growth stages for application, recommended surfactants and oils, withholding and plant back periods, etc.

Pre-emergent herbicides

- Cyanazine 900g/kg (e.g. Bladex®) at 1.1kg/ha
- Diuron 900g/kg (e.g. Diurex® WG) at 0.55–1.1kg/ha
- Flumioxazin 500g/kg (e.g. Terrain®) at 180g/ha
- Imazethapyr 700g/kg (e.g. Spinnaker® WDG) at 70g/ha
- Metribuzin 750g/kg (e.g. Stacato®, Mentor® WG) at 180–380g/ha (PSPE* only, use lower rate on light sandy soils and higher label rates on heavy clay loam soils)
- Pendimethalin 440g/L (e.g. Stomp®) at 1.5–2.25L/ha
- Propyzamide 900g/kg (e.g. Imtrade Edge® 900 WG) at 0.56–1.11kg/ha
- Prosulfocarb 800g/L + s-metolachlor 120g/L (e.g. Boxer Gold®) at 2.5L/ha
- Simazine 900g/kg WG at 1.1–1.4kg/ha (use lower rate on lighter soil types)
- Terbuthylazine 875g/kg (e.g. Terbyne® Xtreme®) at 0.6–1.2kg/ha
- Tri-allate 500g/L (e.g. Avadex® Xtra) at 1.6L/ha
- Trifluralin 480g/L (e.g. TriflurX®) at 800mL/ha plus 1.1 kg/ha Nufarm Simazine 900 DF

* PSPE = Post-sowing pre-emergent

Post-emergent herbicides for broadleaf weed control

- Pyraflufen-ethyl 20g/L (e.g. Ecopar®) at 800mL/ha
- PBA Bendoc$^{\phi}$ was released in 2018 as the first faba bean line with improved tolerance to imidazolinone (IMI) herbicides and the residues of some Group B herbicides including some sulfonylureas. There is a permit (PER86849) for use of imazamox 33g/L + imazapyr 15g/L (e.g. Nufarm Intercept®) at 750mL/ha on IMI-tolerant faba bean varieties such as Bendoc$^{\phi}$. The permit is valid till 30 April 2022. Intercept® has efficiency on both grass and broadleaf weeds.

Post-emergent herbicides for grass weed control

- Butroxydim 250g/kg (e.g. Factor® WG) at 80–180g/ha
- Clethodim 240g/L (e.g. Select®, Status®) at 150–500mL/ha
- Fluazifop-p 128g/L (e.g. Fusilade® Forte) at 410mL/ha
- Haloxyfop-R 520g/L (e.g. Verdict®) at 50–100mL/ha
- Propaquizafop 100g/L (e.g. Shogun®) at 200–450mL/ha
- Quizalofop-p-ethyl 200g/L (e.g. Elantra® Xtreme®, Leopard® 200) at 65–190mL/ha
- Sethoxydim 186g/L (e.g. Sertin®) at 0.5–1L/ha

Insect control

- The main insect pest is native budworm (*Helicoverpa*) and crops need to be monitored regularly late in the season for grubs.
- Budworm control is vital if human consumption quality beans are to be produced.
- Spray if one or more grubs per 10 sweeps.
- Crops also need to be monitored for red-legged earth mite, lucerne flea, cutworm and cowpea aphid.

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Diseases

- Avoid previous year's bean stubble and only grow beans once every four years in the same paddock.
- New bean cultivars have superior disease resistance to those widely grown in the 1990s. Combined with advances in fungicide and spray technology, the risk of epidemics seen in the late 1990s are much lower.
- Ascochyta blight mostly occurs in the Southern Agricultural Region, and becomes evident in the first month after sowing. In the north, do not buy seed from the south. Many newer varieties have excellent Ascochyta resistance and it is less common to see symptoms, but monitoring is still recommended.
- Chocolate spot (*Botrytis fabae*) is the main disease that will require control in WA. Growers should plan to apply the majority of fungicide around flowering to maximise pod set. Monitor crops in late vegetative stage for symptoms with an aim to spray at canopy closure/start of flowering.
- Rust usually occurs from September in WA. Early detection and control is necessary.

Suggested fungicides and timing

It is common to have more than one disease in your crop and fungicide mixes may be required.

Ascochyta

- Early vegetative stages – monitor to ensure disease is apparent.
- Suggested fungicides are mancozeb or Veritas® (tebuconazole + azoxystrobin) or Aviator® Xpro® (prothioconazole + bixafen).

Chocolate spot

- At canopy closure/flowering.
- Suggested fungicides are carbendazim, procymidone, Veritas® (tebuconazole + azoxystrobin), or Aviator® Xpro® (prothioconazole + bixafen) and chlorothalonil.

Cercospora

- Often seen 6–8 weeks after sowing.
- Suggested fungicides are Veritas® (tebuconazole + azoxystrobin) or Aviator® Xpro® (prothioconazole + bixafen) and tebuconazole (refer PER13752).

Rust

- only if greater than five per cent leaf coverage after flowering.
- suggested fungicides are mancozeb, chlorothalonil, Veritas® (tebuconazole + azoxystrobin), or Aviator® Xpro® (prothioconazole + bixafen) and tebuconazole (refer PER13752).

Crop-topping

- Paraquat 250g/L (e.g. Gramoxone®) at 400 or 800mL/ha.
- Spray the crop when the annual ryegrass is at the optimum stage, that is when the last annual ryegrass seed heads at the bottom of the plant have emerged and the majority are at or just past flowering (with anthers present or glumes open) but before haying off is evident – usually October to November.
- Reduction in crop yield may occur (more than 25 per cent) especially if the crop is less advanced relative to the ryegrass; that is, if crops have a majority of green immature pods. The higher label rate may also increase any yield reduction. DO NOT harvest within seven days of application.

Desiccation

- Diquat 200g/L (e.g. Reglone®) at 2 to 3L/ha. Spray as soon as the crop has reached full maturity. It helps overcome slow and uneven ripening and weed problems at harvest. Do not harvest for seven days after application.
- Glyphosate 690g/kg (e.g. Roundup Ready® Herbicide with PLANTFIELD®) at 250 to 1400g/ha. Apply when faba bean pods turn black and average seed moisture content is below 30 per cent. Application before this time may significantly reduce yields (in practice losses in excess of 25 per cent can occur). Use lower rate if ryegrass is flowering and higher label rate if ryegrass is at milky dough stage. Use higher label rates where crops or weeds are dense and faster desiccation is required. DO NOT use on crops intended for seed or sprouting. DO NOT harvest within seven days of application.
- Saflufenacil 700g/kg (e.g. Sharpen® WG) 34g/ha in mixture with label rate of glyphosate or paraquat plus plus 1% Hasten or high-quality methylated seed oil (MSO) of the spray volume. Apply when 30–80 per cent of pods are ripe and dark (hilum black in the pods at the top of the canopy). Earlier applications made before the recommended growth stage may result in grain yield losses. Do not harvest within seven days of application.

Harvesting

- Faba beans turn black at maturity and are ready to harvest when the pods are black and stems are still slightly green.
- Delayed harvest will increase the risk of staining, lodging, shattering and pod loss. Handle seed minimally to reduce physical damage.
- Use a conventional open front header. Alternate wires and blanking off plates may need removing. Use barley sieves.

Reel speed: 1.0 x ground speed

Spiral clearance: High	Fan speed: High
Drum speed: 300–600rpm	Concave clearance: 15–35mm
Top sieve: 32–38mm	Bottom sieve: 8–16mm

Stubble grazing

- Faba bean stubble can be a useful sheep feed over summer, but avoid over-grazing stubbles on fragile soils.
- Most of the feed value is in the spilt grain. Leave sheep in the paddock no longer than is necessary to recover the spilt grain to minimise risk of wind erosion.
- Graze soon after harvest, relying on summer rain to stabilise the soil or late in autumn after most of the erosion risk has passed.

FIELD PEA

INTRODUCTION

Field pea is the most widely adapted pulse species to WA conditions and is grown in most regions. It is adapted to a wide range of soil types and there is widespread experience among growers and their agronomists. A feature of field pea is the excellent weed control options available, which combined with delayed sowing and crop-topping results in very clean paddocks for following crops.

The majority of field peas grown in WA are of the dun grade – either Kaspa$^{\Phi}$ types or Australian dun – e.g. Parafield. Kaspa$^{\Phi}$ types are favoured in the Indian subcontinent, while some sprouting markets still favour trailing varieties such as PBA Percy$^{\Phi}$ and Parafield. White varieties are rarely grown in WA, therefore the marketing of white peas can be problematic. Mixing white and dun types together will result in a downgrade to feed.

WHAT IS NEW?

PBA Butler$^{\Phi}$ was released in 2017. It is a mid-to-late flowering semi-dwarf with a semi-leafless canopy. In WA, it produces a noticeably taller and bulkier canopy than most other field pea varieties. PBA Butler$^{\Phi}$ produces Kaspa$^{\Phi}$-type dun seeds. It has improved bacterial blight and downy mildew resistance compared with other Kaspa-types. PBA Butler$^{\Phi}$ is available from Seednet (EPR $2.70/t).

WHAT VARIETY SHOULD I GROW?

PBA Butler$^{\Phi}$ and PBA Gunyah$^{\Phi}$ are the top-yielding Kaspa$^{\Phi}$-type field pea varieties in WA. PBA Wharton$^{\Phi}$ also produces high yields in trials but most growers have found PBA Gunyah$^{\Phi}$ and in recent times PBA Butler$^{\Phi}$ to produce superior results on-farm.

For growers wishing to plant trailing field pea types, PBA Percy$^{\Phi}$ reliably out-yields Parafield.

TABLE 1 Grain yield of field pea varieties in Agzone 1 expressed as a per cent of site mean yield for each trial year (2015–18).

Year		2015	2016	2017	2018
Site mean yield (t/ha)		2.33	2.02	0.60	1.48
	No. of trials	(1)	(2)	(2)	(2)
Kaspa$^{\Phi}$	(7)	102	73	100	99
Parafield	(7)	65	70	76	71
PBA Butler$^{\Phi}$	(7)	99	109	102	112
PBA Gunyah$^{\Phi}$	(7)	104	88	105	103
PBA Oura$^{\Phi}$	(7)	82	103	91	94
PBA Pearl$^{\Phi}$	(7)	77	102	76	110
PBA Percy$^{\Phi}$	(7)	85	102	114	93
PBA Twilight$^{\Phi}$	(7)	103	80	99	99
PBA Wharton$^{\Phi}$	(6)	106	94	100	93

SOURCE: NVT ONLINE, NVTONLINE.COM.AU

TABLE 2 Grain yield of field pea varieties in Agzone 2 expressed as a per cent of site mean yield for each trial year (2014–18).

Year		2014	2015	2016	2017	2018
Site mean yield (t/ha)		1.72	1.70	1.93	1.47	0.66
	No. of trials	(3)	(3)	(2)	(3)	(1)
Kaspa[Φ]	(12)	92	92	59	97	111
Parafield	(7)	-	65	47	79	61
PBA Butler[Φ]	(12)	114	96	107	103	110
PBA Gunyah[Φ]	(11)	98	99	75	100	100
PBA Oura[Φ]	(12)	87	92	93	93	54
PBA Pearl[Φ]	(9)	-	94	103	92	44
PBA Percy[Φ]	(11)	90	83	56	97	48
PBA Twilight[Φ]	(11)	89	101	72	98	92
PBA Wharton[Φ]	(12)	90	110	98	100	91

SOURCE: NVT ONLINE, NVTONLINE.COM.AU

TABLE 3 Grain yield of field pea varieties in Agzone 3 expressed as a per cent of site mean yield for each trial year (2014–18).

Year		2014	2015	2016	2017	2018
Site mean yield (t/ha)		2.13	0.45	0.46	1.65	1.10
	No. of trials	(1)	(2)	(1)	(1)	(1)
Kaspa[Φ]	(6)	102	65	49	95	71
Parafield	(5)	-	41	33	69	97
PBA Butler[Φ]	(6)	120	81	107	129	104
PBA Gunyah[Φ]	(6)	103	88	68	92	86
PBA Oura[Φ]	(6)	101	100	95	78	117
PBA Pearl[Φ]	(5)	-	94	124	96	110
PBA Percy[Φ]	(6)	99	84	30	63	124
PBA Twilight[Φ]	(6)	96	97	70	78	79
PBA Wharton[Φ]	(6)	84	128	102	73	94

SOURCE: NVT ONLINE, NVTONLINE.COM.AU

TABLE 4 Grain yield of field pea varieties in Agzone 4 expressed as a per cent of site mean yield for each trial year (2014, 2016–18).

Year		2014	2016	2017	2018
Site mean yield (t/ha)		1.35	1.91	1.07	1.92
	No. of trials	(1)	(1)	(1)	(1)
Kaspa[Φ]	(4)	92	64	99	102
Parafield	(3)	-	62	64	61
PBA Butler[Φ]	(4)	98	99	103	104
PBA Gunyah[Φ]	(4)	100	83	106	106
PBA Oura[Φ]	(4)	97	103	88	89
PBA Pearl[Φ]	(3)	-	96	80	98
PBA Percy[Φ]	(4)	103	94	105	88
PBA Twilight[Φ]	(4)	99	79	101	105
PBA Wharton[Φ]	(4)	105	104	102	103

SOURCE: NVT ONLINE, NVTONLINE.COM.AU

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TABLE 5 Grain yield of field pea varieties in Agzone 5 expressed as a per cent of site mean yield for each trial year (2014–18).

Year		2014	2015	2016	2017	2018
Site mean yield (t/ha)		2.30	2.00	1.70	1.55	1.33
	No. of trials	(2)	(3)	(3)	(6)	(5)
Excell[Ф]	(2)	-	-	62	-	-
Kaspa[Ф]	(19)	97	94	104	92	90
Parafield	(11)	-	83	87	85	73
PBA Butler[Ф]	(19)	117	111	116	108	92
PBA Gunyah[Ф]	(19)	99	99	103	95	98
PBA Oura[Ф]	(19)	95	100	93	95	93
PBA Pearl[Ф]	(17)	-	109	98	94	77
PBA Percy[Ф]	(19)	101	103	103	95	103
PBA Twilight[Ф]	(19)	89	93	94	90	98
PBA Wharton[Ф]	(19)	84	91	85	93	110
Sturt	(2)	-	-	96	-	-

SOURCE: NVT ONLINE, NVTONLINE.COM.AU

TABLE 6 Agronomic characteristics of field pea varieties suited to WA.

Variety	Seed type	Plant habit	Plant vigour, early season	Flowering time	Maturity time	Lodging	Pod shattering	Boron tolerance	Salinity tolerance
Kaspa[Ф]	Kaspa dun	SD-SL	Moderate	Late	Mid	Fair-good	R: SP	S	S
PBA Butler[Ф]	Kaspa dun	SD-SL	High	Mid-late	Mid	Good	R: SP	S	S
PBA Gunyah[Ф]	Kaspa dun	SD-SL	High	Early-mid	Early	Fair-good	R: SP	S	SMS
PBA Oura[Ф]	Aus dun	SD-SL	Moderate	Early-mid	Early	Fair-good	MR: NSP	MS	S
PBA Pearl[Ф]	White	SD-SL	Moderate	Early-mid	Early-mid	Good	MR: NSP	MS	MS
PBA Percy[Ф]	Aus dun	C	High	Early	Early	Poor	MR: NSP	S	MT
PBA Twilight[Ф]	Kaspa dun	SD-SL	High	Early	Early	Fair-good	R: SP	S	S
PBA Wharton[Ф]	Kaspa dun	SD-SL	Moderate	Early-mid	Early	Fair-good	R: SP	MT	MT
Sturt	White	C	High	Early-mid	Mid	Poor	MR: NSP	S	MS

SOURCE: VICTORIAN WINTER CROP SUMMARY 2019

SD=semi-dwarf, C=conventional, SL= semi-leafless, S=susceptible, MS=moderately susceptible, MR=moderately resistant, R=resistant, SP=sugar pod type pod, NSP=non sugar pod type, I=intolerant, MI=moderately intolerant, MT= moderately tolerant

TABLE 7 Resistance of field pea varieties to diseases commonly found in WA crops.

Variety	Blackspot[a]	Downy mildew		PSbMV[b]	Nematode resistance	
		Kaspa strain	Parafield strain		*Pratylenchus thornei*	*Pratylenchus neglectus*
Excell	MS	S	MR	-	MRMS	MRMS
Kaspa[Ф]	MS	MS	MR	S	MRMS	MRMS
Parafield	MS	S	S	-	MR	MRMS
PBA Butler[Ф]	MS	MS	S	S	MRMS	MRMS
PBA Gunyah[Ф]	MS	S	R	S	MRMS	MR
PBA Oura[Ф]	MS	MRMS*p*	MR*p*	S	MRMS	MRMS
PBA Pearl[Ф]	MRMS*p*	S	MS	S	MRMS	MRMS
PBA Percy[Ф]	MS	S	S	S	RMR	MRMS
PBA Twilight[Ф]	MS	S	R	S	MRMS	MRMS
PBA Wharton[Ф]	MS	S	R*p*	R	MR	MRMS
Sturt	MS	S	MS	-	MR	MRMS

SOURCE: JENNY DAVIDSON (PIRSA–SARDI)

a – also known as Ascochyta blight, b – pea seedborne mosaic virus
Resistance order from best to worst: R > RMR > MR > MRMS > MS > MSS > S > SVS > VS. *p*=provisional assessment, ratings may change

TABLE 8 Resistance of field pea varieties to diseases rarely found in WA crops.

Variety	Powdery mildew	Bacterial blight		Bean leafroll virus
		pv syringae	pv pisi	
Kaspa(Φ)	S	S	S	S
Parafield	S	MS	-	-
PBA Butler(Φ)	S	MRMS	MRMS	S
PBA Gunyah(Φ)	S	S	-	S
PBA Oura(Φ)	S	MRMS	MRMS	R
PBA Pearl(Φ)	S	MS*p*	MS*p*	R
PBA Percy(Φ)	*S*	MR	MR	S
PBA Twilight(Φ)	S	S	-	-
PBA Wharton(Φ)	R	S	S	R
Sturt	S	MS	-	-

SOURCE: JENNY DAVIDSON (PIRSA–SARDI)

Resistance order from best to worst: R > RMR > MR > MRMS > MS > MSS > S > SVS > VS. *p*=provisional assessment, ratings may change

FIELD PEA AGRONOMY GUIDE

Paddock selection

- Well-drained loamy sands to clay loams with a pH 4.5–9.0 ($CaCl_2$).
- A soil structure or slope that allows good drainage.
- Ensure rocks and roots are removed to enable a flat and even sowing surface.
- No sulfonylurea herbicide residues such as chlorsulfuron (e.g. Nufarm Lusta®) and triasulfuron (e.g. Logran®).
- Avoid Lontrel® residues.
- A low frost risk.
- A low broad-leaved weed burden.
- To minimise the risk of diseases, do not grow field peas more often than one year in three in the same paddock, or adjacent to last year's field pea stubble.
- Because field pea stubble does not provide good protection against wind erosion after harvest, it should not be grown on soils with a sandy surface prone to wind erosion.

Varieties

- It may be advisable to only grow the same type of varieties on your farm to avoid admixture of white peas within dun peas, or vice versa, as it may result in downgrading.

High-quality seed

- When sourcing new seed, where possible, use certified seed where details of germination percentage, seed size and presence of seed borne diseases are provided.
- Avoid seed with high levels of fungal infection – use seed with less than 15 per cent blackspot infection.
- If using uncertified seed, seed from low-rainfall areas is likely to carry less blackspot infection than seed from high-rainfall areas.

A good start

- Plant at the correct time.
- Planting immediately after the break increases the severity of blackspot by exposing field pea seedlings to releases of spores that occur in autumn.
- During the growing season, DPIRD produces a field pea sowing time guide, which is available on the web (https://www.agric.wa.gov.au/field-peas/blackspot-field-peas-disease-forecast) and also by SMS.
- The ideal sowing window for field pea occurs seven to 28 days after the break of the season irrespective of the rainfall zone. Varieties grown in WA are best suited to sowing in the following window with adjustments each year being based on the blackspot forecast.

Low rainfall

- Early May – mid June

Medium rainfall

- Mid May – late June

High rainfall

- Late May – late June

Seeding rate

- On average, the optimum plant density is 50 plants/m^2.
- Actual sowing rates will depend on seed size, germination percentage and field pea type.
- In most situations, a seeding rate of 120 kg/ha is adequate.

Seeding depth

- Recommended planting depth is 5–8cm.

Inoculum

Seed should be inoculated with Group E inoculum every year, particularly on marginal (acid) soil types. With a good history of field pea and alkaline soils, inoculating in WA mallee areas may not be necessary. With pickled seed, sow seed within 6–10 hours of inoculation.

Fertiliser

- A maintenance application of 50–100kg/ha superphosphate is recommended.
- Fertiliser treated with fungicides such as flutriafol may reduce early blackspot infection in high-risk areas.

Rolling

- Field pea paddocks should be rolled with rubber tyre or steel rollers to level the paddock surface as well as partially burying any cereal stubble, rocks and/or sticks present after sowing.
- Rolling can occur either before the crop emerges or after the three-node growth stage.
- Rolling should not be done two weeks before or after the application of post-emergent herbicides.
- It should be done before the plants are 20–25cm tall.

Weed control

- The delayed sowing of field pea, which is necessary to avoid blackspot, provides a good opportunity to control weeds using knockdown herbicides or cultivation.
- Field pea should be planted in paddocks with as few broadleaf weeds, such as doublegee, wild mustard and wild radish, as possible. For these reasons field pea should be sown into paddocks such as cereal stubbles and the weeds primarily controlled pre-sowing.

Numerous following herbicides are registered on field pea in WA. It is advised to check labels of specific herbicide products for rates, crop and weed growth stages for application, recommended surfactants and oils, withholding and plant-back periods, etc.

Pre-emergent herbicides

- Cyanazine 900g/kg (e.g. Bladex®) at 1.1kg/ha
- Dimethenamid-P 720g/L (e.g. Outlook®) at 1L/ha
- Diuron 900g/kg (e.g. Diurex® WG) at 0.55–1.1kg/ha
- Flumioxazin 500g/kg (Terrain®) at 180g/ha
- Imazethapyr 700g/kg (e.g. Spinnaker® WDG) at 70g/ha
- Metribuzin 750g/kg (e.g. Stacato®) at 180–380g/ha (Use an IBS* application when furrow seeding using knife points and press wheels and PSPE** when application is made to flat surface following harrows and/or rolling of the paddock. Use lower rate on light sandy soils and higher label rates on heavy clay loam soils.)
- Pendimethalin 440g/L (e.g. Stomp®) at 1.5–2.25L/ha
- Propyzamide 900g/kg (e.g. Imtrade Edge® 900 WG) at 0.56–1.11kg/ha
- Prosulfocarb 800g/L + s-metolachlor 120g/L (e.g. Boxer Gold®) at 2.5L/ha
- Pyroxasulfone 850g/kg (e.g. Sakura®) at 118g/ha
- Terbuthylazine 875g/kg (e.g. Terbyne® Xtreme®) at 0.6–1.2kg/ha
- Tri-allate 500g/L (e.g. Avadex® Xtra) at 1.6L/ha
- Trifluralin 480g/L (e.g. TriflurX®) at 1.2–1.7L/ha
- Trifluralin 350g/L + Tri-allate 550g/L (e.g. Jetti Duo®) at 1.45–1.8L/ha

* IBS = Incorporated by sowing

** PSPE = Post-sowing pre-emergent

Post-emergent herbicides for broadleaf weed control

- Cyanazine 900g/kg (e.g. Bladex®) at 0.55–1.1kg/ha
- Diflufenican 500g/L (e.g. Brodal® Options, Bonanza® Elite) at 100–200mL/ha
- Flumetsulam 800g/kg (Broadstrike®) at 25g/ha
- Imazamox 700g/kg (e.g. Raptor®) at 45g/ha
- Metribuzin 750g/kg (e.g. Stacato®) at 180–380g/ha (Use lower rate on light sandy soils and higher label rates on heavy clay loam soils up to three-node stage of the crop. Consider alternatives to avoid damage on lighter soil types.)
- MCPA 250g/L K and Na salts (e.g. Nufarm MCPA 250) at 1L/ha
- Picolinafen 750g/kg (e.g. Conquest Glocker 750 WG Herbicide, Sniper®) at 33-50g/ha
- Pyraflufen-ethyl 20g/L (e.g. Ecopar®) at 400mL/ha + 200mL/ha Aspect® Options (diflufenican 500g/L) or 400mL/ha + 200g/ha Stacato® 750 (metribuzin 750g/kg) for medium to heavy soils only (see restraints on the Ecopar® label)

Post-emergent herbicides for grass weed control

- Butroxydim 250g/kg (e.g. Factor® WG) at 80–180g/ha
- Clethodim 240g/L (e.g. Select®, Status®) at 150–500mL/ha
- Diclofop-methyl 375g/L (e.g. Rhino®) at 1–2L/ha
- Fluazifop-p 128g/L (e.g. Fusilade® Forte) at 500mL/ha
- Haloxyfop-R 520g/L (e.g. Verdict®) at 50–100mL/ha
- Propaquizafop 100g/L (e.g. Shogun®) at 200–450mL/ha
- Quizalofop-p-ethyl 200g/L (e.g. Elantra® Xtreme®, Leopard® 200) at 65–190mL/ha
- Sethoxydim 186g/L (e.g. Sertin®) at 0.5–1L/ha

Insect control

- During emergence, monitor crop for red-legged earth mite and lucerne flea.
- Following emergence, monitor crop for pasture looper cutworm.
- During and after flowering, monitor for pea weevil and budworm.
- Budworm can reduce grain quality considerably. The plant is very susceptible to budworm from flowering through to pod fill. Spray if there are one or more grubs/10 sweeps of a sweep net. Spray before the grubs grow to 1cm. Controlling large grubs (20–25mm) is costly as the majority of the damage to the crop has already occurred for the grubs to grow to this size.
- At early flowering spray for pea weevil as the first pods are appearing – 10 to 14 days after flowering commences. Border spraying is an effective strategy in most areas. Control of pea weevil is needed when there are more than 1 weevil/100 sweeps of a sweep net (human consumption) or one weevil/10 sweeps (stock feed).
- Some growers try to control budworm and pea weevil with one spray – very careful monitoring is required for this to be successful.

Diseases

Blackspot is the most serious disease of field pea. It can be minimised by:

- sowing field pea at least 500m from previous seasons' pea stubble;
- not sowing in paddocks where peas were grown in the past three years; and
- sowing crops after the majority of spores (60 per cent) have been released.

Marketing

- Field peas finds a ready market as a component in animal feed rations due to its high lysine content.
- Given WA's time of harvest and geographic location, varieties that can be split can be sold as whole seed to South-East Asia and the Indian subcontinent for human consumption.
- Field pea can be delivered to CBH in some locations.
- Buyers of field pea are readily available in Perth and Esperance.

Crop-topping

- Paraquat 250g/L (e.g. Gramoxone®) at 400 or 800mL/ha.
- Spray the crop when the annual ryegrass is at the optimum stage; that is, when the last annual ryegrass seed heads at the bottom of the plant have emerged and the majority are at or just past flowering (with anthers present or glumes open) but before haying off is evident – usually October to November.
- Reduction in crop yield may occur (more than 25 per cent) especially if the crop is less advanced relative to the ryegrass; that is, if crops have a majority of green immature pods. The higher label rate may also increase any yield reduction. DO NOT harvest within seven days of application.

Desiccation

- Glyphosate 690g/kg (e.g. Roundup Ready® Herbicide with PLANTSHIELD®) at 250 to 1400g/ha. Apply when field pea seeds turn yellow and average seed moisture content is below 30 per cent. Application before this time may significantly reduce yields (in practice losses in excess of 25 per cent can occur). Use lower rate if ryegrass is flowering and higher label rate if ryegrass is at milky dough stage. Use higher label rates where crops or weeds are dense and faster desiccation is required. DO NOT use on crops intended for seed or sprouting. DO NOT harvest within seven days of application.
- Saflufenacil 700g/kg (e.g. Sharpen® WG) 34g/ha in mixture with recommended label rate of glyphosate or paraquat plus 1% Hasten or high quality methylated seed oil (MSO) of the spray volume. Apply when lower 75 per cent of pods are brown with firm seeds and leathery pods or at 30 per cent seed moisture. Earlier applications made before the recommended growth stage may result in grain yield losses. Do not harvest within seven days of application.

Harvesting

- As field pea lodges at maturity, crop lifters or pea pluckers are often required. In recent years, growers with harvesters that have good height control have successfully harvested semi-leafless field pea using only the reel to bring the crop in – significantly reducing the amount of soil brought into the harvester.
- Field pea is easily threshed so concave clearances should be opened and the drum speed reduced.
- Alternate wires and blanking plates on the concave may need to be removed.

Further reading

GRDC GrowNotes

https://grdc.com.au/resources-and-publications/grownotes

TABLE 9 Suggested harvest settings or modifications for trailing and semi-leafless field pea.

	Trailing e.g. Parafield	Semi-leafless sugar pod varieties e.g. Kaspa
Harvest timing	Cool conditions At beginning of program	Warm conditions – sugar pod plant trait makes the vines ropey and hard to thresh and chop in cool damp conditions Harvest may be delayed provided pea weevil management and marketing is not compromised
Crop lifters	Essential	May be possible to remove lifters if crop is upright, resulting in less dirt in sample
Finger tyne adjustment	Tilted back slightly to assist lifting of material	Set in vertical position to force material down and onto draper fronts
Reel speed	1.1 times ground speed	1.0 to 1.3 times ground speed
Raised cross auger	Not required in most crops	Essential for draper fronts Improves speed of harvest of pluckers Essential for draper fronts
Raised cross auger with paddles on middle section	Not required in most crops	
Lupin breakers	Not required in most crops	Useful addition to raised cross auger for draper fronts and table auger for conventional fronts Essential addition for table auger of plucker fronts if no raised cross auger fitted
Position of broad elevator feeder house auger	Set back	Moving the feeder house auger forward may reduce blockages
Stripper plate		Thought to be a useful addition to stop material building up behind raised cross augers and going over the rear of the table
Flexible fingers above plucker	Useful addition	Useful addition
Wire fence across back of fronts	Useful addition	May assist in light crops but not a reliable method compared with raised cross auger fitted with paddles
Crop dividing coulters	Useful addition	Most setups will benefit
Drum or rotor speed	Low 300–600rpm	Low 300–600rpm
Engine capacity		More power required
Concave	Easy to thresh 10-25 mm	Ensure concave wire gaps are at least 7mm and not blocked. The extra time taken for the increased dry matter to be threshed when sieves are blocked may lead to seed damage.
Fan speed	60–75%	60–75%
Screens	Crop is likely to pick up dirt, fit screens to remove dirt wherever possible	Correct screen size is required or damage will occur due to increased threshing time
Top sieve	20–25mm	20–25mm
Bottom sieve	10–15mm	10–15mm
Straw chopper	Useful addition	Essential due to the ropey nature of the vine

LENTIL

INTRODUCTION

There is a small but rapidly expanding lentil industry developing in the Esperance Port Zone. Growers have had success sowing lentils in mid-to-late April, which has resulted in rapid growth and good yields of 1.4 to 2.5t/ha in recent years. Lentil can also produce good yields when sown in May – albeit the growth is a lot slower.

Lentil grows best on soils with pH above 5.2 and it is particularly susceptible to transient waterlogging. Growers should expect to see greater crop variability across paddocks than most other crops.

There have been issues with herbicide damage on WA soils. Growers are encouraged to seek advice before growing lentil and to choose low broadleaf weed burden paddocks. Modern harvester fronts have made harvesting a lot easier, but it is still important to have clean paddocks and to roll the lentils to ensure a flat surface and minimise header damage.

As WA has only recently recommenced growing lentils disease pressure is low. However, most growers budget one or two fungicide sprays from canopy closure onwards.

WHAT IS NEW?

PBA Hallmark XT$^{\Phi}$ was released in 2018 as a mid-season medium red lentil. XT lentil lines have tolerance to imidazolinone herbicides and reduced sensitivity to some sulfonylurea residues. Intercept® (e.g. imazamox + imazapyr) is permitted for use on PBA Hallmark XT$^{\Phi}$, PBA Hurricane XT$^{\Phi}$ and $^{\Phi}$ up to the five-node stage. PBA Hallmark XT$^{\Phi}$ has produced superior growth and yields than PBA Hurricane XT$^{\Phi}$ in WA experiments and has improved tolerance to BGM. Although it is not as highly rated for boron tolerance as the widely grown variety PBA Bolt$^{\Phi}$, PBA Hallmark XT$^{\Phi}$ has produced comparable yields to PBA Bolt$^{\Phi}$ in Agzone 5 where elevated levels of boron are often found in the subsoil. PBA Hallmark XT$^{\Phi}$ has an EPR of $5.40/t and is licensed to PB Seeds.

PBA Highland XT$^{\Phi}$ was released in 2019 as a herbicide tolerant red lentil variety which will complement other tolerant varieties such as PBA Hallmark XT$^{\Phi}$ and PBA Hurricane XT$^{\Phi}$. It is slightly early flowering than the other XT lines, and has performed well in WA trials. PBA Highland XT$^{\Phi}$ has an EPR of $5.94/t and is licensed to PB Seeds.

WHAT VARIETY SHOULD I GROW?

PBA Bolt$^{\Phi}$ is the most widely grown variety in WA, particularly in the Esperance mallee. Growers have commented favourably on its harvestability and capacity to perform on soils with a sodic sub-soil with elevated levels of boron. PBA Jumbo2$^{\Phi}$ produces high yields in the rest of Australia and offers the best available disease ratings, but in the majority of experiments conducted in WA PBA Jumbo2$^{\Phi}$ has not produced higher yields than PBA Bolt$^{\Phi}$.

PBA Hallmark XT$^{\Phi}$ is seen as a XT line better suited to WA than PBA Hurricane XT$^{\Phi}$, which often lacks vigour in cooler southern regions. PBA Hallmark XT$^{\Phi}$ produces similar sized grain to PBA Bolt$^{\Phi}$, which is likely to enable co-mingling and easier marketing for WA's newly developing lentil industry. PBA Bolt$^{\Phi}$ growers are encouraged to test PBA Hallmark XT$^{\Phi}$ on their farm in 2020.

Grain yield

TABLE 1 Grain yield of lentil varieties in Agzone 1 expressed as a per cent of site mean yield for each trial year.

Year		2014	2017	2018
Site mean yield (t/ha)		0.66	1.16	1.33
	No. of trials	(1)	(1)	(1)
PBA Ace[Ф]	(3)	139	94	104
PBA Blitz[Ф]	(3)	65	105	95
PBA Bolt[Ф]	(3)	116	95	98
PBA Flash[Ф]	(3)	107	90	113
PBA Greenfield[Ф]	(3)	116	111	74
PBA Hallmark XT[Ф]	(3)	118	113	120
PBA Hurricane XT[Ф]	(3)	111	100	89
PBA Jumbo2[Ф]	(3)	101	100	85

SOURCE: NVT ONLINE, NVTONLINE.COM.AU 2014 AND DPIRD STAGE 4

TABLE 2 Grain yield of lentil varieties in Agzone 4 and Agzone 5 expressed as a per cent of site mean yield for each trial year.

Agzone	Agzone 4				Agzone 5			
Year		2014	2015	2018		2016	2017	2018
Site mean yield (t/ha)		0.34	0.53	1.94		1.74	1.31	1.34
	No. of trials	(1)	(1)	(2)	No. of trials	(3)	(4)	(3)
PBA Ace[Ф]	(4)	111	130	102	(10)	105	105	102
PBA Blitz[Ф]	(4)	80	61	109	(10)	96	87	78
PBA Bolt[Ф]	(4)	112	114	92	(10)	105	107	117
PBA Flash[Ф]	(4)	88	101	87	(10)	102	97	101
PBA Greenfield[Ф]	(2)	92	106	-	(7)	-	92	73
PBA Hallmark XT[Ф]	(4)	135	126	99	(10)	105	113	111
PBA Hurricane XT[Ф]	(4)	113	115	104	(10)	99	106	109
PBA Jumbo2[Ф]	(4)	107	106	99	(10)	110	103	95

SOURCE: NVT ONLINE, NVTONLINE.COM.AU AND DPIRD STAGE 4 TRIALS

TABLE 3 Disease ratings for selected lentil varieties.

Variety	Botrytis grey mould	Foliar Ascochyta blight		Seed Ascochyta blight	Nematode resistance	
		South Australia	Victoria		*Pratylenchus thornei*	*Pratylenchus neglectus*
PBA Ace[Ф]	MRMS	R*p*	R	R	MRMS	MR
PBA Blitz[Ф]	MR	MR	MR	MRMS	MRMS	MR
PBA Bolt[Ф]	S	MR*p*	MR	RMR	MR	MR
PBA Flash[Ф]	MRMS	MS	MS	MS	MRMS	MR
PBA Greenfield[Ф]	MR	MRMS	MRMS	MRMS	MR	MR
PBA Hallmark XT[Ф]	RMR	MRMS	MR	MR	MRMS	MR
PBA Hurricane XT[Ф]	MRMS	MRMS	MR	MR*p*	MRMS	MRMS
PBA Jumbo2[Ф]	RMR	R	R	R	MRMS	MR

SOURCE: JENNY DAVIDSON (PIRSA–SARDI)

Resistance order from best to worst: R > RMR > MR > MRMS > MS > MSS > S > SVS > VS. *p*=provisional assessment, ratings may change

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TABLE 4 Lentil variety traits – seed.

Variety	Grade	Seed coat colour	Seed size* (mg)
PBA Ace(Ф)	Medium red	Grey	43
PBA Blitz(Ф)	Medium red	Grey	49
PBA Bolt(Ф)	Medium red	Grey	43
PBA Flash(Ф)	Medium red	Green	46
PBA Greenfield(Ф)	Medium green	Grey	50
PBA Hallmark XT(Ф)	Medium red	Grey	40
PBA Hurricane XT(Ф)	Small red	Grey	34
PBA Jumbo2(Ф)	Large red	Grey	47

* Mean seed size harvested from DPIRD/PBA experiments 2016–18.

TABLE 5 Lentil variety traits.

Variety	Flowering time	Days to flowering*	Maturity	Lodging	Canopy height (cm)#
PBA Ace(Ф)	Mid	132	Mid	MRMS	30
PBA Blitz(Ф)	Early	117	Early	MR	-
PBA Bolt(Ф)	Early-mid	125	Early-mid	R	29
PBA Flash(Ф)	Early-mid	131	Early-mid	MR	26
PBA Greenfield(Ф)	Mid	130	Mid-late	MS	28
PBA Hallmark XT(Ф)	Mid	126	Mid	MR	30
PBA Hurricane XT(Ф)	Mid	124	Mid	MR	25
PBA Jumbo2(Ф)	Mid-Late	125	Mid	MRMS	27

* Sown April 30 at Merredin in 2018. # Dalwallinu Stage 4, 10 September 2019

TABLE 6 Lentil tolerance soil conditions.

Variety	Salinity	Boron
PBA Ace(Ф)	I	I
PBA Blitz(Ф)	I	I
PBA Bolt(Ф)	MI	MI
PBA Flash(Ф)	MI	MI
PBA Greenfield(Ф)	MI	MI
PBA Hallmark XT(Ф)	MI	I
PBA Hurricane XT(Ф)	I	I
PBA Jumbo2(Ф)	I	MI

I=intolerant, MI=moderately intolerant

LENTIL AGRONOMY GUIDE

Paddock selection

- Relatively flat without rocks or large stones.
- Well drained loamy sands to clay loams with a pH above 5.2 ($CaCl_2$).
- Avoid sulfonylurea or Lontrel® (clopyralid) herbicide residues.
- A low broad-leaved weed burden – avoid paddocks with a history of vetch. Avoid paddocks prone to waterlogging.
- XT varieties have improved tolerance to residues.

Rotation

- One in three years.
- Avoid lentil, chickpea, vetch, or faba bean stubble – at least 500 metres away from last year's stubble.

Sowing window

Low and medium rainfall

- April 15 to end of May.
- Best results sown early but increases frost risk in some areas.

High rainfall

- Lentil may not be your best crop choice as it is very susceptible to waterlogging.
- Delay seeding (late May to 20 June) to reduce disease risk.

Sowing depth

- 4 to 6cm.

Seed dressing

- P-Pickel T (thiram + thiabendzole), let dry then apply Group FE inoculum.

Rolling

- Rolling the paddock after sowing improves harvest efficiency and reduces the risk of damage to harvesters.
- Lentil can be rolled either after sowing but before crop emergence or post-emergent at the 3–5 leaf stage.
- Depth of sowing, seeding systems (furrow sowing, harrows, etc.) and time of rolling can alter the safety of herbicides.
- Rolling post-emergent is preferred on lighter soil types in order to reduce wind erosion risk and improve crop safety from herbicides applied incorporated by sowing (IBS).

Fertiliser

- Maintenance of 5–10kg/ha of phosphorus. May be applied with compounds containing nitrogen (MAP, DAP, Agras, etc.) or as single superphosphate.

Target density

- 100–110plants/m^2. Recommended plant density provides better competition with weeds than lower densities and aids efficient harvest.

Seeding rate

- Small-seeded varieties (PBA Hurricane XT$^{\phi}$) 35 to 40kg/ha.
- Medium-sized varieties (PBA Bolt$^{\phi}$, PBA Hallmark XT$^{\phi}$) 40 to 50kg/ha.
- Large-seeded varieties (PBA Jumbo2$^{\phi}$) 50+ kg/ha.

Always check seed size and germination percentage as both vary widely from year to year.

Row spacing

- Similar yield response on wide range of row spacing. Inter-row sowing between last year's cereal rows can assist harvesting and has been shown to increase yields by 10 per cent.

Herbicide options

Pre-emergent herbicides

- Cyanazine 900g/kg (Bladex®) 1.1kg/ha
- Diuron 900g/kg (e.g. Diurex®) at 0.83 to 1.1kg/ha (use lowest rate or consider alternatives to avoid damage on lighter soil types)
- Pendimethalin 440g/L (e.g. Stomp®) at 1.5–2.25L/ha
- Prosulfocarb 800g/L + s-metolachlor 120g/L (e.g. Boxer Gold®) at 2.5L/ha
- Propyzamide 900g/kg (e.g. Imtrade Edge® 900 WG) 0.56–1.1kg/ha
- Pyroxasulfone 850g/kg (e.g. Sakura®) at 118g/ha
- Terbuthylazine 875g/kg (e.g. Terbyne® Xtreme®) at 0.86 to 1.2kg/ha

Post-sowing pre-emergent herbicides

- Diuron 900g/kg (e.g. Diurex®) at 0.55 to 0.83kg/ha. Rolling prior to spraying can improve crop safety. Use lowest rate or consider alternatives to avoid damage on lighter soil types.
- Imazethapyr 100g/kg (e.g. Genfarm Imazethapyr) at 70g/ha (varieties: PBA Herald XT$^{\phi}$ and PBA Hurricane XT$^{\phi}$ ONLY) and 70 to 100g/ha (variety: PBA Hallmark XT ONLY) as per permit PER87042.
- Metribuzin 750g/kg (e.g. Stacato®) at 100–380g/ha. Rolling prior to spraying can improve crop safety. Consider alternatives to avoid damage on lighter soil types. Use lower rate on light sandy soils and higher label rates on heavy clay loam soils. In trials, rolling prior to spraying has shown to improve crop safety.

Post-emergent herbicides

- Diflufenican 500g/L (e.g. Brodal®) at 100–200mL/ha
- Flumetsulam 800g/kg (e.g. Broadstrike®) at 25g/ha
- Imazamox 33g/L and imazapyr 15g/L (e.g. Intercept®) – XT (IMI tolerant) varieties only: under permit PER87417

Post-emergent herbicides for grass weed control

Lentil markets have low tolerance for cereals so include products in grass selective mixes that control volunteer cereals.

- Butroxydim 250g/kg (e.g. Factor® WG) at 80–180g/ha
- Clethodim 240g/L (e.g. Select®, Status®) at 150–500mL/ha

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- Haloxyfop-R 520g/L (e.g. Verdict®) at 50–100mL/ha
- Propaquizafop 100g/L (e.g. Shogun®) at 200–450mL/ha
- Quizalofop-p-ethyl 200g/L (e.g. Elantra® Xtreme®, Leopard® 200) at 65–190mL/ha
- Sethoxydim 186g/L (e.g. Sertin®) at 0.5–1L/ha

Aphid threshold

- More than 30 per cent of plants colonised.

Budworm threshold

- One caterpillar per 30 sweeps – very low.

Disease management

Botrytis grey mould (BGM)

- BGM is the most likely disease to be prevalent in WA lentil crops. Regular crop monitoring and protection will be required in high-risk situations – e.g. immediately adjacent to last year's crop; in bulky, dense canopies sown with narrow row spacing; non-optimal paddock selection (e.g. waterlogging); high disease pressure experienced last year; or a susceptible variety is planted; or lentil was grown on the paddock in past two years.
- Varieties vary in their susceptibility to BGM. Ranging from susceptible (e.g. PBA Bolt(I)) to resistant–moderately resistant (RMR) (e.g PBA Jumbo2(I)).
- Best time to apply the first fungicide for BGM is just before canopy closure, which occurs around 12 weeks after sowing. Follow-up applications may be required during early to mid flowering to maintain protection, depending on the varietal susceptibility (R and MR varieties may not require follow-up sprays in low-risk situations), growth and seasonal conditions. Depending on seasonal conditions, further sprays may become necessary through pod filling.

Suggested fungicides for BGM*

- 500mL/ha carbendazim (500g ai.i/L) e.g. Spin Flo®
- 500mL/ha procymidone (500g a.i./L) e.g. Sumisclex®, Fortress®
- 0.75 to 1L/ha of Veritas® (200g/L tebuconazole +120 g/L azoxystrobin)
- 400 to 600mL/ha of Aviator® xPro® (150g/L prothioconazole + 75g/L bixafen)

Ascochyta blight

- Most varieties grown in WA are rated MRMS or higher for resistance to Ascochyta, therefore early sprays may not be required. Monitor crops. Spraying may be required during podding to produce clean seed.

Suggested fungicides for Ascochyta*

- 1 to 2L/ha of chlorothalonil (720g a.i./L) e.g. Barrack®
- 0.75 to 1L/ha of Veritas® (200g/L tebuconazole +120g/L azoxystrobin)
- 400 to 600mL/ha of Aviator® xPro® (150g/L prothioconazole + 75g/L bixafen)
- 1 to 2.2kg/ha of mancozeb (750g a.i./kg) e.g. Dithane®

* Visit Pulse Australia website to find latest fungicide product information: http://www.pulseaus.com.au/growing-pulses/crop-protection-products

Crop-topping

- Paraquat 250g/L (e.g. Gramoxone®) at 400 or 800mL/ha.
- Spray the crop when the annual ryegrass is at the optimum stage; that is, when the last annual ryegrass seed heads at the bottom of the plant have emerged and the majority are at or just past flowering (with anthers present or glumes open) but before haying off is evident – usually October to November.
- Reduction in crop yield may occur (more than 25 per cent) especially if the crop is less advanced relative to the ryegrass; that is, if crops have a majority of green immature pods. The higher label rate may also increase any yield reduction. DO NOT harvest within seven days of application.

Desiccation

- Diquat 200g/L (e.g. Reglone®) at 2 to 3L/ha. Spray as soon as the crop has reached full maturity – more than 50 per cent of seeds have colour change to yellow-buff.
- Glyphosate 690g/kg (e.g. Roundup Ready® Herbicide with PLANTSHIELD®) at 530 to 1400g/ha. Apply when physiologically mature and less than 15 per cent green pods. Use higher label rates where crops or weeds are dense and faster desiccation is required. DO NOT harvest within seven days of application. Application to crops intended for seed production may reduce germination percentage to commercially unacceptable levels.
- Saflufenacil 700g/kg (e.g. Sharpen® WG) 34g/ha in mixture with recommended label rate of glyphosate or paraquat plus 1% Hasten or high-quality methylated seed oil (MSO) of the spray volume. Apply just after crop starts to yellow (or senesce). Sharpen® WG may have a negative effect on lentil germination. Do not use Sharpen® WG on lentil crops for seed production.

Harvesting

- Harvesting reel speed slightly faster than ground speed.
- Table auger 7–10mm.
- Drum or rotor speed 300–600rpm.
- Concave clearance 10–12mm (start at clearance 10mm).

VETCH

By Mark Seymour and Harmohinder Dhammu (DPIRD), Stuart Nagel (SARDI) and Gregg Kirby (SARDI)

INTRODUCTION

Vetch is a multi-purpose crop grown mostly for a disease break in rotation with cereals in a wide range of soil types from light sands to heavier clay soils. Common vetch varieties' (Morava$^{\Phi}$, Rasina$^{\Phi}$, Volga$^{\Phi}$ and Timok$^{\Phi}$) versatility allows cropping for grain or hay production, early grazing as green pasture or for dry grazing, hay production or green manure. Grain vetches have been grown in lower to mid-rainfall cereal areas and their grain yields have been similar to pea yields.

Vetch grain is not used for human consumption due to the presence of neurotoxins. Common vetch grain can be used without limit to feed all ruminants and can be used in pig rations up to a maximum inclusion rate of 20 per cent. Modern varieties such as Morava$^{\Phi}$, Rasina$^{\Phi}$, Volga$^{\Phi}$ and Timok$^{\Phi}$ possess less toxin in grain (<0.65 per cent) compared with older varieties such as Blanchefleur (0.95 per cent) and Languedoc (1.65 per cent).

Forage vetches are used for hay, green manure or mid-to-late winter feed for grazing. They include purple vetch (*V. benghalensis* – e.g Barloo) and or woolly pod vetches (*V. villosa ssp.* – e.g. RM4$^{\Phi}$). Grain from woolly pod vetch varieties CANNOT be used to feed any livestock.

Disease management is critical when growing a vetch crop regardless of the end use. Where possible, disease-resistant varieties should be planted. The most common disease in WA vetch is Botrytis grey mould (BGM), which likes cool/wet growing seasons with high amounts of vegetative growth. Although there is little difference between vetch varieties in their resistance to BGM, varieties such as Morava$^{\Phi}$, which produce greater levels of vegetative growth and denser canopies, will be more prone to this disease in higher-rainfall areas.

Ascochyta blight occurs in earlier stages of the vetch crop and can reduce grain and dry matter production, but it is less common than BGM in WA. Later in the season rust can also infect common vetch varieties that are not resistant and damage can occur very quickly in spring. Care must be taken when growing rust-susceptible varieties as grazing or feeding hay/silage from rust-infected plants may induce abortions in pregnant livestock. Fortunately, newly released common vetch varieties have good resistance to rust.

WHAT VARIETIES SHOULD I GROW?

Rasina$^{\Phi}$, Volga$^{\Phi}$ and Timok$^{\Phi}$ are resistant to rust and are the preferred varieties for grain in areas prone to rust infections. Morava$^{\Phi}$'s late flowering/maturity causes more variable results than other vetch varieties and it is best suited to long seasons.

See Table 2 for suggested grain varieties and Table 3 for suggested hay, silage, grazing and green manure varieties for each rainfall zone in WA.

TABLE 1 Grain yield of grain vetch varieties in Agzones 2, 3 and 5 expressed as a per cent of site mean yield for each trial year.

Agzone	Agzone 2				Agzone 3			Agzone 5		
Year		2016	2017	2018		2015	2016		2016	2017
Site mean yield (t/ha)		1.7	2.5	1.2		1.4	1.2		1.8	2.3
	No. of trials	(1)	(1)	(1)	No. of trials	(1)	(1)	No. of trials	(1)	(1)
Morava[Φ]	(3)	97	109	59	(2)	80	125	(2)	101	33
Timok[Φ]	(3)	110	107	118	(2)	136	96	(2)	93	103
Volga[Φ]	(3)	118	114	123	(2)	101	95	(2)	96	116
Rasina[Φ]	(2)	95	118	-	-	-	-	(1)	-	109

SOURCE: PBA AND DPIRD

TABLE 2 Suggested vetch grain variety by WA rainfall zones.

Low	Medium	High	Very high
Volga[Φ]	Rasina	Timok	Morava
Timok[Φ]	Timok	Rasina	Timok
Rasina[Φ]	Volga	Morava	

TABLE 3 Suggested vetch varieties by WA rainfall for use as dry matter (hay/silage/grazing) or green manure crop.

Use	Low	Medium	High	Very high
Late summer/early autumn sown – grazing	RM4[Φ]	RM4[Φ]	RM4[Φ]	RM4[Φ]
April sown – green manure	RM4[Φ]	RM4[Φ]	RM4[Φ]	RM4[Φ]
	Morava[Φ]	Morava[Φ]	Morava[Φ]	Morava[Φ]
April sown graze and grain	Volga[Φ]	Timok[Φ]	Morava[Φ]	Morava[Φ]
	Timok[Φ]	Volga[Φ]	Timok[Φ]	Timok[Φ]
	Rasina[Φ]	Rasina[Φ]	Volga[Φ]	
		Morava[Φ]		

TABLE 4 Characteristics of selected vetch varieties.

Variety	Maturity	Grain yield	Dry matter yield	Flower colour	% of pod shatter	% of hard seed	Rust	Ascochyta	Botrytis	BCN %
Common vetch varieties (*Vicia sativa*)										
Morava[Φ]	Late	High	High	Purple	0	0	R	S	VS	0.65
Rasina[Φ]	Early-mid	High	Mod	Purple	0–2	0	R	MS	S	0.6
Timok[Φ]	Mid	High	Very high	Purple	0–2	0–2	R	MS	S	0.57
Volga[Φ]	Early	Very high	High	Purple	0–2	2–5	R	MS	S	0.54
Purple vetch (*Vicia villosa ssp. benghalensis*)										
Barloo*	Mid	Low	High	Purple	20–30	5–10	R	S	VS	NS
Popany	Very late	Low	High	Purple	20–30	5–10	R	S	VS	NS
Woolly pod vetches (*Vicia villosa ssp. dasycarpa*)										
Capello[Φ]	Late	Low	Very high	Purple	5–10	15–20	R	S	VS	NS
Haymaker[Φ]	Late	Low	Very high	Purple	5–10	20–30	R	S	VS	NS
RM4[Φ]	Mid	Moderate	Very high	Purple	2–5	2–5	R	MR	VS	NS

* Also known as Early Purple or Early Popany; BCN = cyanoalanines – which limit their safe use for human consumption and some feed markets; NS = grain is not suitable for consumption

DPIRD GRDC

Weed control

The following herbicides are registered on vetch in WA. It is advised to check labels of specific herbicide products for rates, crop and weed growth stages for application, recommended surfactants and oils, withholding and plant-back periods, etc.

Pre-seeding

- Trifluralin 480g/L (e.g. TriflurX®) at 1.7L/ha
- Diuron 900g/kg (e.g. Diurex WG) at 0.830–1.1kg/ha

Post-sowing pre-emergent

- Diuron 900g/kg (e.g. Diurex® WG) at 550–830g/ha
- Metribuzin 750g/kg (e.g. Stacato®) at 180–380g/ha

Post-emergent herbicides for broadleaf weed control

- Flumetsulam 800g/kg (e.g. Broadstrike®) at 25g/ha at three fully expanded leaves onwards (purple or Popany vetch only)
- Pyraflufen-ethyl 20g/L (e.g. Ecopar®) at 800mL/ha

Post-emergent herbicides for grass weed control

- Butroxydim 250g/kg (e.g. Factor® WG) at 80–180g/ha
- Fluazifop-P 128g/L (e.g. Fusilade® Forte) at 820mL/ha
- Haloxyfop-R 520g/L (e.g. Verdict®) at 50–100mL/ha
- Propaquizafop 100g/L (e.g. Shogun®) at 200–450mL/ha
- Quizalofop-p-ethyl 200g/L (e.g. Elantra® Xtreme®) at 65–190mL/ha

Crop-topping

- Paraquat 250g/L (e.g. Gramoxone®) at 400 or 800mL/ha.
- Spray the crop when the annual ryegrass is at the optimum stage; that is, when the last annual ryegrass seed heads at the bottom of the plant have emerged and the majority are at or just past flowering (with anthers present or glumes open) but before haying off is evident – usually October to November.
- Reduction in crop yield may occur (more than 25 per cent) especially if the crop is less advanced relative to the ryegrass; that is, if crops have a majority of green immature pods. The higher label rate may also increase any yield reduction. DO NOT harvest within seven days of application

NOTES

FIGURE 1 Distribution of Mid and Early canola NVT trials across Agzones in Western Australia.

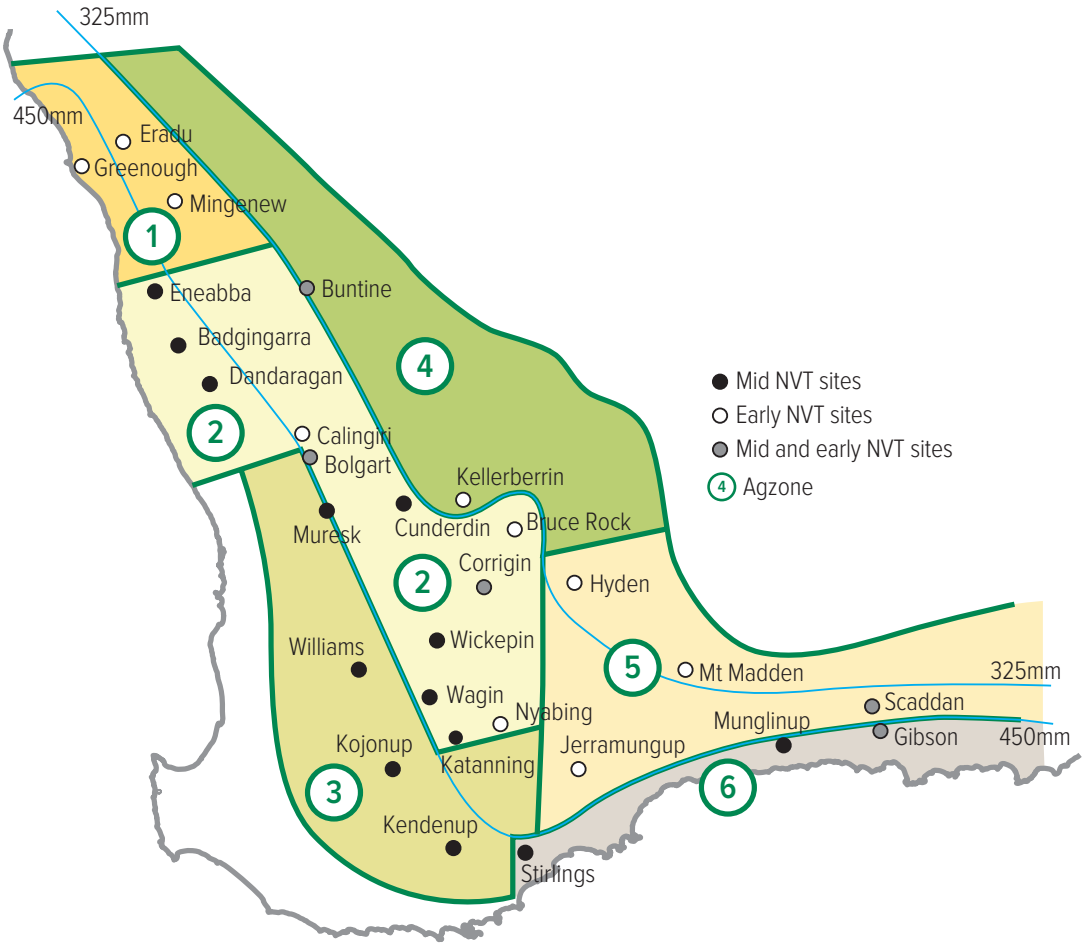

FIGURE 2 Lupin agzone map for Western Australia.