SOUTHERN
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GRDC GROWNOTES™

GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

FABA BEAN

SECTION 3

PRE-PLANTING

KEY POINTS | BEAN TYPES | VARIETY SELECTION | AREA OF ADAPTION | VARIETY PERFORMANCE AND YIELD | NVT APPS FOR COMPARING VARIETIES | QUALITY TRAITS | SOUTHERN FABA BEAN VARIETIES | SOUTHERN BROAD BEAN VARIETIES | FABA BEAN VARIETY SEED AVAILABILITY | SEED QUALITY | SEED TESTING

Pre-planting

Key points

- Faba bean and broad bean are more suitable for soils prone to waterlogging than other pulse crops.
- Broad bean is more suited to the high-rainfall zone as it requires a longer growing season.
- New varieties offer significant yield and disease-resistance improvements compared with older varieties.
- A variety with a specific trait such as a specific disease resistance may not necessarily yield as well as others, but disease resistance will reduce risk.
- Good-quality, undamaged seed is essential to ensure the best start for the crop.
- Test seed for germination percentage, weed contamination and disease.

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3.1 Bean types

The beans grown in Australia can be divided into two types. The smaller faba bean (*Vicia faba* var. *minor* and *Vicia faba* var. *equina*) and the larger broad bean (*Vicia faba var. major*). Broad bean is virtually identical to faba bean, but requires a slightly longer growing season and is usually grown in the high-rainfall areas.[1]

3.1.1 Faba bean types

Faba bean market categories for Australian growers include:

- the now-traditional medium-seeded faba bean markets, where seed size (50–70 g/100 seeds) and uniformity is important to attract market interest along with light colour (Fiesta VF type);
- the larger-seeded faba bean class where seed size (70–95 g/100 seeds) and uniformity is important for marketing along with pale colour (old Manafest, now PBA Rana$^{\Phi}$ type); and
- the small-seeded (35–50 g/100 seeds) class that used to be exported for human consumption markets, but is now considered too small and dark in all but a few niche markets (Fiord type).

The requirements of faba beans in terms of size and colour vary between importing countries and also according to the end use:[2]

- The predominant colour for international trade is beige or buff and to a large extent is genetically determined and highly heritable.
- Colour can also be influenced by the environment in which the crop is grown, post-harvest handling, time in storage and storage method.
- Seed size of faba bean can vary from 35 to 90 g/100 seeds according to the variety; e.g. small (Fiord, Ascot VF, Barkool), medium (Fiesta VF, Farah$^{\Phi}$, Nura$^{\Phi}$, PBA Samira$^{\Phi}$) and large faba bean (PBA Rana$^{\Phi}$, PBA Zahra$^{\Phi}$ and the superseded varieties Manafest and Icarus).
- Seed size is also influenced by the region (rainfall, soil type etc.) and season.

3.1.2 Broad bean types

Seed size of broad bean (Aquadulce, PBA Kareema$^{\Phi}$) is considerably larger than most faba bean, ranging from 100 to 170 g/100 seeds. They are of a light-brown to brown colour similar to Fiesta types. Broad bean market categories for Australian growers are based on size produced after grading for uniformity.

Market grade for broad bean size is usually classified by ‘count‘ (seeds per 100 g) or sometimes by size (mm). Screens of 8, 11 or 14 mm are commonly used, with at least 70% of beans above that screen being required for the ‘count’.

- The preferred market size is large broad beans, commonly over 14 mm in size (65–70 grades or ‘count’, which is 140–160 g/100 seeds),
- The medium-seeded broad bean grades (70–80 or 80–90 grades, which is 110–145 g/100 seeds),
- The small-seeded broad bean grade (90–110 grade, which is 90–100g/100 seeds).
- There is a very large market size of broad bean, commonly up to 17 mm in size (40–50, 50–55 grades or ‘count’, which is 180–220 g/100 seeds). Current broad bean varieties cannot achieve this grade.

Broad bean size produced depends on seasonal conditions and the environment where they are grown. The longer maturity restricts broad bean to the high-rainfall regions of south-east South Australia and south-west Victoria where they are well suited.

1 Pulse Australia (2016) Best management guide .Faba bean production: Southern and Western Region. Pulse Australia, 15 January 2016, http://pulseaus.com.au/growing-pulses/bmp/faba-and-broad-bean/southern-guide

2 Pulse Australia (2016) Southern faba and broad bean best management practices training course – 2016. Pulse Australia.

FEEDBACK

3.2 Variety selection

Some bean varieties have limitations in agronomic adaptation and marketability and will not suit all areas or situations (e.g. broad bean, PBA Rana$^{\Phi}$).

When selecting a variety consider:

- season length;
- seed size with reference to sowing machinery;
- disease susceptibility to chocolate spot, Ascochyta blight and, to some degree, rust;
- seed availability;
- lodging resistance;
- maturity timing;
- yield potential;
- price potential; and
- market opportunities.

A variety with a highly specific trait such as disease resistance may not necessarily yield as well as another variety bred specifically for yield, but that resistance trait will diminish risk.

Varietal resistance to chocolate spot is extremely important as this disease is a potential problem with faba bean and broad bean in higher-rainfall areas, irrigated crops or wetter years. There is limited varietal resistance, so a strategic foliar fungicide program is essential in most areas.

The availability of varieties resistant to Ascochyta blight now lowers the disease risk for faba bean in southern Australia. Ascochyta blight-resistant varieties require fewer and later fungicide applications than those with less resistance, but still require fungicide control of chocolate spot. PBA Samira$^{\Phi}$ has good resistance to the new Ascochyta pathotype 2 that has been identified in the Mid North of South Australia.

Farah$^{\Phi}$ and Fiesta VF have lower resistance to chocolate spot and rust than the newer varieties and are more suited to areas with low disease pressure.

All varieties are susceptible to Cercospora.

PBA Rana$^{\Phi}$, PBA Samira$^{\Phi}$ and PBA Zahra$^{\Phi}$ have more potential to take advantage of good seasons in high-rainfall environments.

3.2.1 Introducing a new variety

Southern region growers who plan to introduce a new variety or sow several varieties of faba bean should ensure there is at least 500 m between those different varieties. Faba bean cross-pollinate, increasing the risk of disease resistance breaking down and producing mixed seed types that are difficult to market.

In practice, sowing a small area of a new variety into a separate, isolated paddock is difficult to do with small quantities purchased. The compromise when sowing the two varieties close to each other is to ensure that there is only a short distance where they are adjacent to each other. Then only retain the grain harvested for seed from furthest away from the other variety. This means that those areas of the new variety that are close to the other variety are not mixed in with the seed and are marketed only as commercial grain. More seed than originally planned needs to be purchased to achieve this compromise.

3.3 Area of adaption

Faba bean and broad bean varieties are bred for a range of different environments. These are categorised by Pulse Breeding Australia (PBA) into five regions based on rainfall and geographic location (Figure 1). Most faba bean varieties are adapted to Zones 4 and 5.

The area of adaption is specified for each variety so that potential users are aware of their best fit. Breeding trials and National Variety Trials (NVT) help indicate specific adaptation even within a region.

Faba bean and broad bean are more tolerant to soils prone to waterlogging than other pulse crops, but will experience higher disease pressure in these situations. Broad bean are more suited to the high-rainfall zone as they require a longer growing season.

Some of the newer varieties such as PBA Zahra$^{\Phi}$ offer substantial yield improvements in the high-rainfall zone. Southern Farming Systems are trialling faba bean in Tasmania with excellent results.[3]

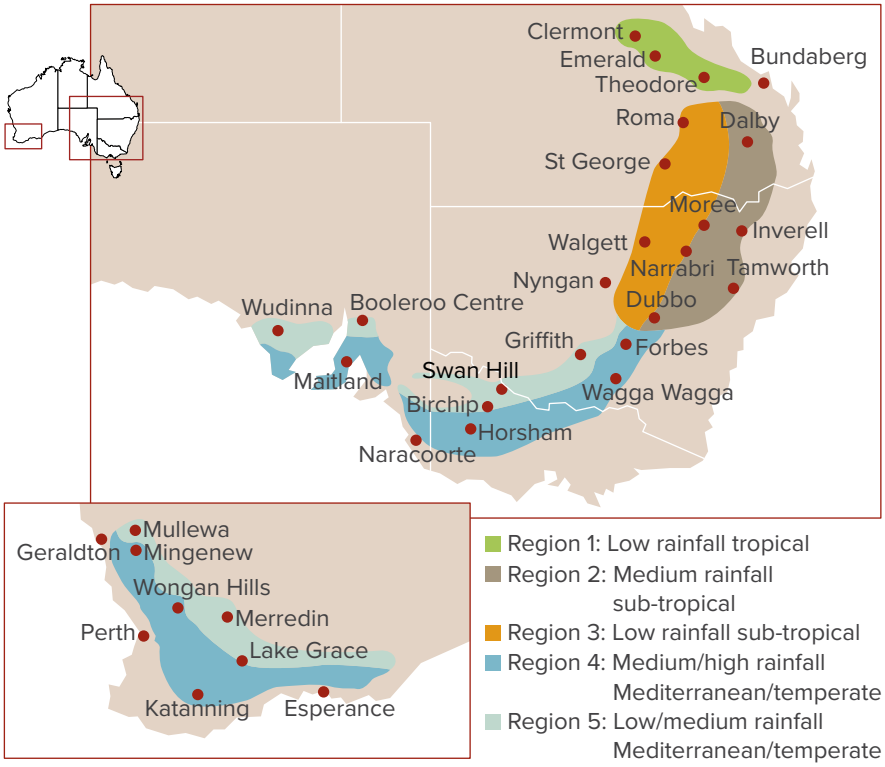

Figure 1: *Pulse Breeding Australia regions used to describe the area of adaption.*

Source: Pulse Breeding Australia

Broad bean are late to fill and mature and do not respond well to hot, dry finishes; however, they are more resistant to chocolate spot than faba bean. Broad bean require a cool finish to develop large, uniform seeds and will generally yield more than faba in high-rainfall areas.[4]

3 B Collis (2016) Grain with a history takes root in the Apple Isle. GroundCover Issue 124 September–October, https://grdc.com.au/Media-Centre/Ground-Cover/Ground-Cover-Issue-124-SeptemberOctober-2016/Grain-with-a-history-takes-root-in-the-Apple-Isle

4 J Paull (2010) Faba bean variety trial – Dunkeld, Victoria. 2009 Trial report. Southern Farming Systems. pp. 74–75, http://www.farmtrials.com.au/trial/15943

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3.4 Variety performance and yield

NVT grows current and potential varieties in multiple locations across all grain-growing regions in Australia. NVT trials are sown and managed as closely as possible to local best practice such as sowing time, fertiliser application, and weed, pest and disease management.

Growers are able to look at the annual yield and quality results for each variety at individual locations as well as regional and multi-year averages. The long-term yield averages for each region provide a guide to potential yield of each variety (Tables 1 and 2).

Table 1: Long-term yield of faba bean in National Variety Trials in South Australia, 2008–15.

	Lower EP		Mid North		Murray Mallee		South East		Upper EP		Yorke Peninsula	
Mean yield (t/ha)	2.2		2.77		1.48		2.78		1.66		3.52	
	Mean yield (%)	No. of trials	Mean yield (%)	No. of trials	Mean yield (%)	No. of trials	Mean yield (%)	No. of trials	Mean yield (%)	No. of trials	Mean yield (%)	No. of trials
Aquadulce	–		–		–		93	(13)	–		–	
Doza^{Φ}	101	(10)	94	(27)	88	(3)	88	(19)	–		93	(6)
Farah^{Φ}	98	(10)	99	(37)	103	(8)	101	(36)	97	(5)	100	(16)
Fiesta VF	98	(10)	99	(37)	103	(8)	102	(35)	97	(5)	100	(16)
Fiord	98	(7)	91	(22)	–		90	(18)	–		102	(4)
Manafest	–		93	(3)	–		89	(10)	–		–	
Nura^{Φ}	97	(10)	97	(37)	105	(8)	95	(36)	96	(5)	101	(16)
PBA Kareema^{Φ}	–		–		–		91	(13)	–		–	
PBA Nasma^{Φ}	–		102	(8)	–		100	(6)	–		–	
PBA Rana^{Φ}	94	(10)	94	(37)	92	(8)	94	(36)	89	(5)	92	(16)
PBA Samira^{Φ}	103	(4)	105	(21)	107	(4)	106	(20)	100	(4)	103	(8)
PBA Warda^{Φ}	105	(6)	99	(19)	–		98	(11)	–		–	
PBA Zahra^{Φ}	105	(4)	109	(21)	109	(4)	109	(19)	101	(4)	107	(8)

Source: NVTOnline (2016)

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Table 2: Long-term yield of faba bean in National Variety Trials in Victoria, 2008–15.

	North Central		North East		South West		Wimmera	
Mean yield (t/ha)	4.97		2.58		3.45		2.33	
	Mean yield (%)	No. of trials	Mean yield (%)	No. of trials	Mean yield (%)	No. of trials	Mean yield (%)	No. of trials
Aquadulce	–		–		88	(4)	–	
Doza[Φ]	–		87	(3)	–		97	(8)
Farah[Φ]	96	(6)	102	(8)	100	(6)	100	(28)
Fiesta VF	96	(6)	103	(8)	102	(6)	100	(22)
Fiord	–		–		–		99	(6)
Nura[Φ]	96	(6)	101	(8)	99	(6)	96	(28)
PBA Kareema[Φ]	–		–		91	(4)	–	
PBA Rana[Φ]	91	(3)	99	(8)	101	(6)	94	(28)
PBA Samira[Φ]	103	(4)	108	(4)	109	(4)	104	(14)
PBA Zahra[Φ]	106	(4)	111	(4)	109	(4)	104	(14)

Source: NVTOnline (2016)

Long-term yield predictions provided in this report have been produced using the NVT long-term multi environment trial (MET) analysis. The analysis produces predictions or 'production values' for every variety in every NVT trial across all years identified within the dataset. This report presents regional means for each variety, which reduces the accuracy and reliability of the results. Varieties present in less than three trials per region have been omitted from this report and some rounding variation may be present when compared with other reporting methods. More detailed yield information can be found using the NVT Long Term Yield Reports app or the Excel reporting tools available on the NVTOnline (www.nvtonline.com.au).

3.5 NVT apps for comparing varieties

NVT has launched two apps to help growers compare crop varieties. They can be downloaded from the NVT website (http://www.nvtonline.com.au/interactive-tools/apps/).

3.5.1 Yield app

The NVT Long Term Yield Reports app was developed to provide growers and advisers with an easy-to-use means of accessing and interpreting the data from the GRDC-funded NVT program.

The app dynamically aggregates the site mean yields into 0.5 t/ha increments and compares and presents the variety performances values in an easy-to-read table or graph. Users can select the state, region, site or group of sites. It is linked directly to the NVT database and will update automatically when additions are made to the data providing users with live data.

The app is available for Windows PC, Apple iPad and Android tablets.

3.5.2 Disease app

The Crop Disease Au app (NVT/GRDC) provides quick access to current disease resistance ratings, disease information and an extensive disease image library.

Compare disease symptoms with photographs and access detailed descriptions of each disease with management controls. Explore detailed information on crop

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varieties, map diseases and automatically share photographs with friends or colleagues via email.

With live feeds from the NVT database, variety information will always be up to date and information on newly released varieties will become instantly available upon their release.

The app is available for Android and iOS.

3.6 Quality traits

To access the export human food markets, Australian beans must be of a high quality and free from mechanical damage, weathering and disease staining and storage problems. Faba bean darken over time while in storage and seed can become unsuitable for the export market after about 9 months.

The medium-sized varieties are well accepted in the Middle East. The medium seed size 'Fiesta grade' is expected to remain the dominant quality type as it is currently well accepted in the Middle Eastern market and is also easier to manage for on-farm operations. The PBA faba bean breeding program has a major focus on developing new varieties to fit this grade.

The characteristics of the current varieties are listed in Table 3.

Market signals indicate that small-seeded faba bean varieties, such as the old Fiord and Ascot VF varieties, are no long desired in the Middle East. Mixing smaller-seeded varieties into the accepted larger Fiesta grade will downgrade the overall quality of the product.

PBA Rana$^{\Phi}$ and PBA Zahra$^{\Phi}$ seed is larger than other varieties and is considered to be of high quality by the major Egyptian market, representing a different grain category for faba bean growing and marketing in Australia. New varieties will also be developed for the large-seed type where premium prices might be obtained.

Table 3: Faba bean and broad bean agronomic guide.

Variety	Seed size	Seed size (g/100)	Seed colour	Plant height	Flowering time	Maturity	Lodging
Faba bean							
Farah$^{\Phi}$	Medium	55–75	Light brown to brown	Medium	Early to mid	Early to mid	MS
Fiesta VF	Medium	55–75	Light brown to brown	Medium	Early to mid	Early to mid	MS
Nura$^{\Phi}$	Small to medium	50–70	Light buff	Short	Mid	Early to mid	MR
PBA Rana$^{\Phi}$	Medium to large	65–85	Light brown	Medium/tall	Mid	Mid	MR
PBA Samira$^{\Phi}$	Medium	55–75	Light brown	Medium	Mid	Mid	MR
PBA Zahra$^{\Phi}$	Medium to large	60–85	Light brown	Medium/tall	Mid	Mid to late	MR
Broad bean							
Aquadulce	Large	110–150	Light buff	Tall	Late	Mid to late	MS
PBA Kareema$^{\Phi}$	Large	130–170	Light brown	Tall	Late	Late	MS

MR – moderately resistant, MS – moderately susceptible

Source: Victorian Winter Crop Summary 2017, and Pulse Australia (2016)

The choice of variety mainly determines seed size and colour. However, management from seeding to delivery can affect quality, with seed downgraded due to shrivelling,

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MORE INFORMATION

L McDonald (2017) Image analysis to quantify pulse quality traits. GRDC Update Paper February 2017: https://grdc.com.au/resources-and-publications/grdc-update-papers

L McMurray (2017) Pulse performance and agronomy update. GRDC Update Paper February 2017: https://grdc.com.au/resources-and-publications/grdc-update-papers

seed discoloration, breakage and insect damage. This damage will also lead to poor emergence and vigour when seed is sown.

Seed staining in beans is caused by:

- genetics (natural ageing, and high-tannin grains are more likely to discolour);
- late rain on maturing or mature crops;
- Ascochyta blight (susceptible varieties are more prone to discoloration, especially after late rains);
- exposure due to pod splitting (commonly caused by chocolate spot infection);
- frost;
- other diseases including Pea seed-borne mosaic virus (PSbMV); and/or
- poor storage conditions, including high moisture or exposure to sunlight.

3.7 Southern faba bean varieties

Please note that the specific disease-resistance ratings listed below are updated each season as pathogens evolve to overcome resistance. Always check the updated disease ratings each year in the current Crop Variety Guides for each state or on the NVT Crop Disease Au app.

3.7.1 Fiesta VF

Fiesta VF (Photo 1) has average yields similar to Farah(ϕ). It has early-to-mid flowering and maturity with good seedling vigour. Area of Adaption: Zone 4 and 5 (irrigated).[5]

Fiesta VF was the first Australian faba bean variety with medium-sized seed and is widely adapted throughout the southern region. It does not have the Ascochyta blight resistance of the newer varieties. As it is moderately resistant to moderately susceptible (MRMS) to pathotype 1 of Ascochyta blight and susceptible (S) to pathotype 2, it is only suited to regions where the risk is low or well managed. Fiesta VF is susceptible to chocolate spot and rust.

Fiesta VF is a medium-sized bean.

Released 1998. Fiesta VF is no longer protected by plant breeder's rights (PBR) and no end-point royalty (EPR) applies.

Photo 1: *Fiesta VF.*

Source: Pulse Australia

5 Pulse Australia (2011) Fiesta VF Variety Management Package. Pulse Australia, http://pulseaus.com.au/storage/app/media/crops/2011_VMP-Fababean-FiestaVF.pdf

3.7.2 Farah$^{\Phi}$

Farah$^{\Phi}$ (Photo 2) has average yields, similar to Fiesta VF, and performs best in medium-rainfall environments. It has early-to-mid flowering and maturity. Area of Adaption: Zone 4 and 5 (irrigated). [6]

It has better resistance to Ascochyta blight pathotype 1 than Fiesta VF but is susceptible to pathotype 2. It is susceptible to chocolate spot and rust. Farah$^{\Phi}$ may be preferred to Nura$^{\Phi}$ where the risk of chocolate spot is low, where sowing time is delayed or in low-rainfall areas where the shorter Nura$^{\Phi}$ may be at a disadvantage.

Farah$^{\Phi}$ has a medium seed size and is known for uniform seed size.

Released 2004, Heritage Seeds, EPR $3.00 ex-GST.

Photo 2: *Farah$^{\Phi}$.*

Source: Pulse Australia

6 Pulse Australia (2011) Farah$^{\Phi}$ Variety Management Package. Pulse Australia, http://pulseaus.com.au/storage/app/media/crops/2011_VMP-Fababean-Farah.pdf

FEEDBACK

3.7.3 Nura$^{\phi}$

Nura$^{\phi}$ (Photo 3) has average yields with wide adaptation throughout southern Australia. It is mid-flowering and has early-to-mid maturity. Nura$^{\phi}$ needs to be sown early particularly in low to medium-rainfall areas as it flowers about 7 days later than Fiesta VF, but it matures at a similar time. It is not suitable for late sowing. Nura$^{\phi}$ is a shorter plant that is less likely to lodge; however, the bottom pods are closer to the ground, which can make harvest more difficult. Area of Adaption: Zone 4 and 5 (irrigated).

It has good overall disease resistance and is resistant to moderately resistant (RMR) to both pathotypes of Ascochyta blight. As with other newer varieties it is moderately susceptible (MS) to chocolate spot and rust.

Nura$^{\phi}$ has a small to medium seed size and is suited to Egyptian markets.

Nura$^{\phi}$ is more sensitive to high rates of imazethapyr (e.g. Spinnaker®) than Farah$^{\phi}$ but is more tolerant of simazine and metribuzin.

Released 2005. Seednet. EPR $3.00 ex-GST.

Photo 3: *Nura$^{\phi}$.*

Source: Pulse Australia

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3.7.4 PBA Rana$^{\Phi}$

PBA Rana$^{\Phi}$ (Photo 4) is a relatively late flowering and maturing variety suited to higher-rainfall, long-season regions. It is a vigorous plant with mid flowering and mid-maturity. Area of Adaption: Zone 4 and 5 (irrigated).

It has good overall disease resistance and is resistant to pathotype 1 of Ascochyta blight, but moderately resistant to moderately susceptible (MRMS) to pathotype 2. As with other newer varieties, it is moderately susceptible (MS) to chocolate spot and rust.

PBA Rana$^{\Phi}$ has a large seed size and is suited to Middle Eastern markets.

Released 2011. Seednet. EPR $3.50 ex-GST. Tested as AF10060/15-1 or 974*(611*974)/15-1.

Photo 4: *PBA Rana*$^{\Phi}$.

Source: Pulse Australia

FEEDBACK

3.7.5 PBA Samira$^{\Phi}$

PBA Samira$^{\Phi}$ (Photo 5) is a high-yielding variety with wide adaptation throughout southern Australia. It is a vigorous plant with mid to late-flowering and mid-maturity. While it flowers relatively late it matures at the same time as other varieties. It can perform very well in longer-season environments. Area of Adaption: Zone 4 and 5.

It has good overall disease resistance and is resistant to both pathotypes of Ascochyta blight. As with other newer varieties it is moderately susceptible (MS) to chocolate spot and rust.

PBA Samira$^{\Phi}$ has a medium seed size and is suited to Middle Eastern markets.

Released 2015. Developed by PBA (as AF05069-2). Seednet. EPR $3.50 ex-GST.

Photo 5: *PBA Samira$^{\Phi}$.*

Source: Pulse Australia

3.7.6 PBA Zahra$^{\phi}$

PBA Zahra$^{\phi}$ (Photo 6) is a high-yielding variety with wide adaption throughout southern Australia. It is the most recent release from the PBA faba bean breeding program and in the right conditions has the highest yield of current varieties. It is better suited to higher-rainfall, long-season regions. It is a vigorous plant with mid-flowering and mid-to-late maturity that can perform very well in longer-season environments. Area of Adaption: Zone 4 and 5.

It has good overall disease resistance and is resistant to pathotype 1 of Ascochyta blight, but moderately resistant to moderately susceptible (MRMS) to pathotype 2. As with other newer varieties it is moderately susceptible (MS) to chocolate spot and rust.

PBA Zahra$^{\phi}$ has a large uniform seed size, similar to PBA Rana$^{\phi}$, and is suited to Middle Eastern markets.

Released 2016. Developed by PBA (as AF05095-1). Seednet. EPR $3.50 ex-GST.

Photo 6: *PBA Zahra$^{\phi}$.*

Source: Pulse Australia

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3.8 Southern broad bean varieties

3.8.1 Aquadulce

Aquadulce (Photo 7) is a tall broad bean with late flowering and maturity suited to high-rainfall areas. It is more tolerant to waterlogging than most faba bean varieties and can tolerate soils with iron and manganese deficiencies. Area of Adaption: Zone 4 (SA and Victoria).

It is moderately susceptible (MS) to Ascochyta blight pathotypes 1 and 2, chocolate spot and rust.

Aquadulce has a large seed size and can attract a price premium over faba bean. Aquadulce is being superceded by PBA Kareema(ϕ).

Released 1982. Aquadulce is not protected by PBR, and no EPR applies.

Photo 7: *Aquadulce.*

Source: Pulse Australia

3.8.2 PBA Kareema(ф)

PBA Kareema(ф) (Photo 8) is a tall broad bean with late flowering and maturity suited to high-rainfall areas. It is a direct replacement for Aquadulce and is also more tolerant of waterlogging than most faba bean and can tolerate soils with iron and manganese deficiencies. Area of Adaption: Zone 4 (SA & Victoria).

It is resistant to moderately resistant (RMR) to pathotype 1 and moderately resistant (MR) to pathotype 2 of Ascochyta blight, moderately resistant to moderately susceptible (MRMS) to rust and moderately susceptible (MS) to chocolate spot.

It has a larger and more uniform seed than Aquadulce with no 'evergreen' seeds. It can attract a price premium over faba bean.

Released 2009. PGG Wrightson Seeds. EPR $4.00 ex-GST.

Photo 8: *PBA Kareema(ф).*

Source: Pulse Australia

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3.9 Faba bean variety seed availability

Seed can be sourced from the suppliers listed in Table 4.

Table 4: Seed distribution arrangements and end-point royalties of faba and broad bean.

Registered PBR Name	PBR	Type	Variety owner	Royalty manager charged with EPR collection	EPR rate $/t (GST exclusive)	Seed distribution arrangements 2016	Grower sales permitted
Farah[Φ]	Yes	Faba bean	University of Adelaide	Heritage Seeds	$3.00	Heritage Seeds Broadacre Agents	No
Fiesta VF	No	Faba bean	University of Adelaide	N/A	–		
Nura[Φ]	Yes	Faba bean	University of Adelaide	SeedNet	$3.00	SeedNet	No
PBA Rana[Φ]	Yes	Faba bean	University of Adelaide	SeedNet	$3.50	SeedNet	No
PBA Samira[Φ]	Yes	Faba bean	University of Adelaide	SeedNet	$3.50	SeedNet	No
PBA Zahra[Φ]	Yes	Faba bean	University of Adelaide	SeedNet	$3.50	SeedNet	No
Aquadulce	No	Broad bean	None	N/A	–	–	
PBA Kareema[Φ]	Yes	Broad bean	University of Adelaide	PGG Wrightson Seeds	$4.00	PGG Wrightson Seeds	No

Source: Variety Central (2016)

3.10 Seed quality

High-quality seed is essential to ensure the best start for the crop. High-quality seed will germinate well providing the correct plant density and good seedling vigour.

Grower-retained seed, if not tested, may be of poor quality with reduced germination and vigour, as well as being infected with seed-borne pathogens. To maximise germination and early vigour:

- all seed should be tested for quality including germination and vigour (see Section 3.11 Seed testing for more information);
- if grower-retained seed is of low quality then consider purchasing registered or certified seed from a commercial supplier (always ask for a copy of the germination report regardless of the source);
- pay careful attention to the harvest, storage and handling of seed intended for sowing (see Section 12 Harvest and Section 13 Storage for more information); and
- use knowledge of seed quality (germination, vigour and seed size) to calculate seeding rates (see Section 4 Planting for more information).

It is important to know or test the germination rate to accurately calculate seeding rates for the targeted sowing density. A slight variation in seed size due to seasonal conditions or an incorrect germination percentage can make a significant difference in the final plant density.

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Many seed buyers are unaware that the minimum germination requirement for certified pulse seed is only 70% compared with 80% in cereal grains and far less than 90% or greater that is often obtained in pulse seed. Test results must be made available under the *Seeds Act 1985* (see https://www.legislation.tas.gov.au/view/html/inforce/current/act-1985-087), and Australian Seed Federation guidelines, so ensure you receive a copy.

Seed quality problems often occur when the crop does not get harvested under ideal moisture or seasonal finishing conditions. A sharp seasonal finish, a wet harvest or delayed harvest can have a significant impact on seed quality. Seed may also be damaged by frost.

The large size or fragile nature of pulse seed, particularly faba bean and broad bean, makes them more vulnerable to mechanical damage during harvest and handling. This damage is not always visually apparent.

Rotary harvesters and belt conveyors are ideally suited to pulse grain and can reduce seed damage that often results in abnormal seedlings that germinate but do not develop further. Damage can be reduced by slowing header rotor speed and opening the concave, or by reducing auger speed and lowering the flight angle and fall of grain.

Low germination rates and poor seedling vigour can cause slower and uneven emergence that can result in sparse establishment and a weak crop. It can also be more vulnerable to virus infection, fungal disease and insect attack, and less competitive with weeds. Any of these can result in significantly lower yields.

Under ideal conditions abnormal seedlings may emerge, but will lack vigour. Factors such as low temperature, disease, insects, seeding depth, soil crusting and compaction are more likely to affect the establishment of weak seedlings. Those that do emerge are unlikely to survive for long or produce less biomass and make little or no contribution to final yield.

Diseases such as chocolate spot and Ascochyta blight can carryover from one season to the next on infected faba bean seed. Purchase disease-free seed or retain seed from the healthiest crop to avoid carryover on infected seed (see Section 9 Diseases for more information).

3.10.1 Sowing grower-retained seed

When saving seed, select the best area of a paddock and mark the area out well before harvest (see Section 12 Harvest for more information). Choose an area where weeds and diseases are absent and the crop is vigorous and healthy and likely to mature evenly with a good grain size. Seed from this area should be harvested first, ideally between 11–13% moisture to avoid low-moisture grain that is susceptible to cracking.

Glyphosate is not registered for seed crops (see Section 11 Pre-harvest treatments for more information). If desiccation is required do not use glyphosate as normal seed count and vigour can be severely reduced. Crop-topping will also reduce seed viability.

Seed-borne diseases can lower germination levels, and testing for their presence in seed can be conducted by specialist laboratories for several diseases such as Ascochyta blight and *Botrytis* (chocolate spot or grey mould) (see Section 9 Diseases for more information).

Harvest on time to minimise Ascochyta blight and chocolate spot infection on seed. Infection on the pods can spread to seed if harvest is delayed and conditions are wet.

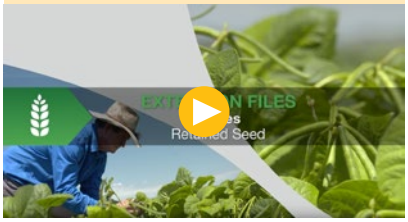
Clean grain after harvest to remove weed seeds.

Seed with poor germination, high levels of seed-borne disease and weed seed contamination should not be sown. The cheaper cost of retaining this seed will often be offset by higher sowing rates needed and the potential risk of introducing further disease or virus into the crop.

FEEDBACK

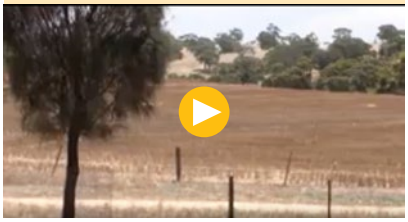
VIDEO

GroundCoverTM TV: Extension Files – Retained pulse seed
https://youtu.be/5lq9T6_f6Tg



VIDEO

GRDC Over the Fence: Ensure seed viability with aerated storage – Apr 2011
https://youtu.be/8HFilsCnka0



The only way to accurately know the seed's germination rate, vigour and disease level is to have it tested.

Growers should also ensure that seed varieties are properly labelled in storage and that different varieties are not accidently mixed and sown together. Sowing varieties with different disease susceptibility will compromise disease management.

3.10.2 Seed storage

Seed quality is at its highest when first loaded into storage, but can steadily deteriorate if the storage environment is not well managed. A combination of good farm hygiene, storage choice and aeration cooling are important for maintaining grain quality and overcoming many problems with pests associated with storage.

Pulse grain placed in storage with high germination and vigour can remain viable for at least 3 years providing the moisture content of the grain does not exceed 11%.

As a general rule, every 1% rise in moisture content above 11% will reduce the storage life of pulse seed by one-third. Any pulse stored above 12% moisture content will require aeration cooling to maintain quality.

High temperatures in storage will cause deterioration in grain viability. Temperatures of stored pulse grain should not exceed an average of 25°C and the average temperature should preferably be below 20°C. In general, each 4°C rise in average stored temperature will halve the storage life of the grain.

While insects are not considered a major problem in stored faba bean and broad bean it is important to practice good hygiene to ensure grain is not damaged (see Section 13 Storage for more information).

3.11 Seed testing

3.11.1 Germination testing

Seed testing laboratories can conduct germination and vigour tests on a representative sample of seed. It is also possible to do a germination test at home. For beans, 1 kg is required for every 25 t of seed.

Sampling should be random and take numerous sub-samples to give best results. It is easier and more accurate to take numerous samples while seed is being moved either out of the seed cleaner, storage or truck or sampling from numerous bags if stored this way.

Do not sample from within a silo: it is dangerous for the operator and it difficult to obtain a representative sample, as is taking samples from the bagging chute. Mix sub-samples thoroughly and take a composite sample of 1 kg. Failure to correctly sample or test seed could result in poor establishment in the field.

If an issue with kept grain is suspected, it is better to get a sample tested early. If the sample is not of sufficient quality the cost of grading and seed treatment can be saved and there will be more time to source replacement seed. If the germination and vigour are below optimal or marginal or the crop was weather damaged at harvest, it may be advisable to have it re-tested closer to harvest after storage, handling and grading to check that quality has been maintained.

Doing your own germination test

Ideally, results from a laboratory germination and vigour test should be used in seeding rate calculations. However, a home test (Photo 9) after harvest can be useful to decide which seed to target for sowing or to check for deterioration in storage.[7]

Use a flat, shallow seeding tray about 5 cm deep. Place a sheet of newspaper on the base to cover drainage holes. Use clean sand, potting mix or a freely draining

7 Pulse Australia (2016) Southern faba and broad bean best management practices training course – 2016. Pulse Australia.

soil. Testing should be at a temperature of less than 20°C, so doing it indoors may be required. Randomly count out 100 seeds per test, but do not discard any damaged seeds.

After the tray has been filled with soil, sow 10 rows of 10 seeds in a grid at the correct seeding depth. Do this by placing the seed on the levelled soil surface and gently pushing each in with a pencil marked to the required depth. Gently cover seed holes with a little more soil and water.

Alternatively, place a layer of moist soil in the tray and level it to the depth of sowing that will be required. Place the seeds as 10 rows of 10 seeds in a grid on the seed bedformed. Then uniformly fill the tray with soil to the required depth of seed coverage (i.e. seeding depth). Ensure that the soil surface is uniformly levelled and water gently if required.

During the test, keep the soil moist, but not wet. Overwatering will result in fungal growth and possible rotting. After seven to 14 days the majority of viable seeds will have emerged. Count only normal, healthy seedlings. The number of normal and vigorous seedlings you count will be the germination percentage.

This germination test is in part a form of inbuilt vigour testing because it is done in soil. To further establish vigour under more adverse conditions, a second germination test done under colder or wetter conditions could be used as a comparison to the normal germination test done at the same time.

Photo 9: *Doing your own germination test.*

Photo: E Leonard, AgriKnowHow

Vigour testing

In years of either drought or a wet harvest seed germination can be reduced, but, more importantly, seedling vigour can also be reduced. Vigour represents the rapid, uniform emergence and development of normal seedlings under a wide range of conditions.[8]

Poor seedling vigour can impact heavily on establishment and early seedling growth. This often occurs under more difficult establishment conditions such as deep sowing, crusting, compaction, wet soils or when seed treatments have been applied.

Some laboratories also offer a seed-vigour test when doing their germination testing. Otherwise conduct your own test by sowing seeds into a soil tray that is kept cold (<20°C) and observing not only the germination but also speed and uniformity of emergence and any abnormal shoot and root development.

8 Australia (2016) Southern faba and broad bean best management practices training course – 2016. Pulse Australia.Pulse

FEEDBACK

Several types of tests are used by seed laboratories to establish seed and seedling vigour.

Accelerated ageing vigour test

Accelerated ageing estimates longevity of seed in storage. It is now also used as an indicator of seed vigour and has been successfully related to field emergence and stand establishment. This tests seed under conditions of high moisture and humidity. Seeds with high vigour withstand these stresses and deteriorate at a slower rate than those with poorer vigour.

Results are expressed as a percentage normal germination after ageing (vigorous seedlings). The closer the accelerated ageing number is to the germination result, the better the vigour.

Conductivity vigour test

The conductivity test measures electrolyte leakage from plant tissues. Conductivity test results are used to rank vigour lots by vigour level.

Having a germination test done as well is important as a conductivity test cannot always pick up all chemical and pathogen scenarios, which may be seed-borne.

Cool germination and cold tests

A cool or cold test evaluates the emergence of a seed lot in cold, wet soils. In the field these conditions can cause poor performance. It is one of the oldest and most widely used vigour tests for many crops.

Uses for this test can include:

- evaluating fungicide efficacy;
- evaluating physiological deterioration resulting from prolonged or adverse storage, freezing injury, immaturity, injury from drying or other causes;
- measuring the effect of mechanical damage on germination in cold, wet soil; and
- providing a basis for adjusting seeding rates.

This test usually places the seed in cold temperatures (5°C–10°C) for a time that is then followed by a period of growth. The seed is evaluated relative to normal seedlings according to a germination test. Some laboratories also categorise the seedlings further into vigour categories and report both of these numbers.

Tetrazolium test as a vigour test

The tetrazolium test is used to test seed viability, but is also useful as a rapid estimate of vigour of viable seeds. Seed is dissected, stained and examined under a microscope. It is conducted in the same manner as a germination test, but viable seeds are evaluated more critically into categories of:

- high vigour: staining is uniform and even, tissue is firm and bright;
- medium vigour: embryo completely stained or embryonic axis stained in dicots; extremities may be unstained; some over-stained/less-firm areas exist; and
- low vigour: large areas of non-essential structures unstained; extreme tip of radicle unstained in dicots; tissue milky, flaccid and over-stained.

Results have shown good relationships with field performance, and are useful for pulses.

Other vigour tests

Another example of a vigour test used by some Australian laboratories is to test germination at 7°C for 12–20 days in the dark and under low-moisture conditions. If seed vigour is acceptable, then this germination result should be within 10% of the regular germination test.

FEEDBACK

3.11.2 Weed-contamination testing

Sowing seed free of weeds cuts the risk of introducing new weeds. It also reduces the pressure on herbicides, especially with increasing herbicide resistance. Tests for purity of a seed sample can be conducted if requested, including the amount and type of weed seed contamination.

3.11.3 Disease testing and major pathogens identified in seed tests

Disease risk can be reduced by using fresh, undamaged and robust seed to prevent disease build-up (see Section 9 Diseases for more information).

Seed-borne diseases such as Ascochyta blight and chocolate spot pose a serious threat to yields. Seed-borne diseases can strike early in the growth of the crop when seedlings are most vulnerable and result in severe plant losses and lower yields.

Seed transmission of viruses in faba bean is minimal relative to the spread by insect vectors, but can be minimised by purchasing virus-tested seed (see Section 9 Diseases for more information).

Testing seed before sowing will identify the presence of disease and allow steps to be taken to reduce the disease risk. If disease is detected, the seed may either be treated with a fungicide before sowing or a clean seed source may be used.

For a disease test, 1 kg of seed is usually required.

3.11.4 Agencies offering seed testing

South Australian Research and Development Institute (SARDI) – Plant Research Centre

Phone: 08 8303 9400

Germination, weed and disease testing, http://pir.sa.gov.au/research/services/crop_diagnostics/seed_and_crop_testing

Tasmanian Department of Primary Industries, Parks, Water and Environment – Plant Health Laboratories

Phone: 03 6165 3252 or 1300 368 550

Email: biosecurity.planthealth@dpipwe.tas.gov.au

Germination and weed testing, http://dpipwe.tas.gov.au/biosecurity-tasmania/plant-biosecurity/plant-health-laboratories/tasmanian-seed-services

Virus testing, http://dpipwe.tas.gov.au/biosecurity-tasmania/plant-biosecurity/plant-health-laboratories/tasag-elisa-testing

AsureQuality

AsureQuality is located in Melbourne.

Phone: 03 8318 9000 or 1800 247 478

Germination testing, https://www.asurequality.com/our-industries/seeds/

MORE INFORMATION

SARDI: Seed and crop testing http://pir.sa.gov.au/research/services/crop_diagnostics/seed_and_crop_testing

Tasmanian DPIPWE: Tasmanian Seed Services http://dpipwe.tas.gov.au/biosecurity-tasmania/plant-biosecurity/plant-health-laboratories/tasmanian-seed-services

Agriculture Victoria: Seed health testing in pulse crops http://agriculture.vic.gov.au/agriculture/pests-diseases-and-weeds/plant-diseases/grains-pulses-and-cereals/seed-health-testing-in-pulse-crops

eXtensionAUS : Disease testing services around Australia http://extensionaus.com.au/field-crop-diseases/disease-testing-services-around-australia/