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GRDC GROWNOTES™

GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

FABA BEAN

SECTION 1

INTRODUCTION

FABA BEAN IN AUSTRALIA | WHY GROW FABA BEAN? | KEY POINTS FOR SUCCESSFULLY GROWING FABA BEAN | PLANT PHYSIOLOGY | PRODUCTS AND USES | MARKET | FABA BEAN RESEARCH

Introduction

1.1 Faba bean in Australia

Faba bean and broad bean account for 10–15% of the annual Australian pulse crop, with between 152,000 and 230,000 hectares planted each year.[1] Approximately 370,000 tonnes are produced annually.[2]

The southern region grows 70% of Australia's faba bean by area sown. In the southern region the gross value of faba bean was $105 million (average from 2010-11 to 2016-17).[3] More recently the area planted has increased, with improved varieties with better disease management packages and better market prices. In addition, growers now recognise the contribution of pulses to managing weeds and diseases in the overall rotation. There is also increasing recognition of the fact that faba and broad bean are the better pulses to grow on soils that can become waterlogged for short periods.

Originating in the Middle East in the prehistoric period, faba bean has since been cultivated throughout Europe, North Africa, and Central Asia. It was introduced to China more than 2,000 years ago via traders along the Silk Road, to South America in the Columbian period, and more recently to Canada and Australia.

The Australian faba bean industry commenced in South Australia in 1981 with the release of the variety Fiord and spread to the higher-rainfall cropping regions in Victoria, New South Wales and Western Australia, but with fluctuating areas sown due to the impact of foliar disease. Faba bean production has stabilised in these states following the release of improved varieties and better agronomic management packages. Small areas are now also grown in Tasmania and southern Queensland.

The early varieties had poor foliar disease resistance and some bad experiences with faba bean losses led growers to nickname them 'failure beans'.[4] Today growers have a better understanding of disease management and newer varieties have improved disease resistance and a more consistent grain quality. Better agronomic management packages have also been developed.

1 AEGIC (2015) Australian Grain Note: Pulses. Australian Export Grains Innovation Centre, http://pulseaus.com.au/storage/app/media/using_pulses/AGN_Pulse-Note-LR.pdf

2 ABARES (2016) Australian crop report: February 2016 No.177. Australian Bureau of Agricultural and Resource Economics and Sciences, Department of Agriculture and Water Resources, http://www.agriculture.gov.au/abares/publications/display?url=http://143.188.17.20/anrdl/DAFFService/display.php?fid=pb_aucrpd9aba_20160209_11a.xml

3 DAWR ABARES (2017) Australian Crop Report. ABARES, http://www.agriculture.gov.au/abares/research-topics/agricultural-commodities/australian-crop-report

4 G Onus (2014) Optimising performance and managing risk in faba beans. GRDC Update Paper 26 August 2014, https://grdc.com.au/Research-and-Development/GRDC-Update-Papers/2014/08/Optimising-performance-and-managing-risk-in-faba-beans

FEEDBACK

MORE INFORMATION

GRDC 2011 Choosing break crops Fact Sheet, (southern region) https://grdc.com.au/Resources/Factsheets/2011/03/Choosing-Break-Crops-South

GroundCover™ TV: Value of pulses in the farming system https://youtu.be/ZfbW40oP0SI

1.2 Why grow faba bean?

Faba bean, along with other pulses, are often considered to be a valuable break crop in a rotation dominated by cereals. However, pulses can be the most profitable crop in the rotation, with the human consumption market willing to pay high prices for good-quality grain.

The benefits of including pulses in the rotation are to:

- diversify crop rotation;
- reduce the need for inputs through nitrogen fixation;
- broaden weed control opportunities, particularly for controlling herbicide-resistant weeds;
- provide a pest and disease break;
- fit well into a cereal-based cropping and stubble-retention system;
- spread the timing of farming operations; and
- spread risk across different crop types.[5]

In particular, pulses fit well when grown in the year before canola to provide a two-year break from cereals and, when planted before the canola, increase soil nitrogen and water reserves, therefore reducing the risk associated with growing canola.

There are some advantages to choosing to grow faba bean rather than an alternate pulse. Faba bean:

- Can be sown both early and into dry soil, allowing growers to spread the timing of farming operations. They can also be harvested early compared with cereals.
- Has a shallower root system and shorter growing season, limiting the use of subsoil moisture.
- Tolerates waterlogging better than other pulse crops, making it more suitable for the high-rainfall zone and the heavier soils in the medium-rainfall zone.
- Cattle can pick up larger grain such as faba and broad bean when grazing stubbles after harvest even when the grain is split. Research has shown that bean and lupin stubble produce better weight gain in young Merino sheep than other pulses.

1.2.1 Weeds

Faba bean provides a good opportunity to use different herbicide groups, thus delaying the onset of herbicide resistance. Faba bean allows growers to target grass weeds including herbicide-resistant weeds, particularly annual ryegrass.

However, faba bean is a moderately poor competitor against weeds until canopy closure and there are limited post-emergent broadleaf herbicide control options for use within pulse crops. Effective use of knockdown and pre-emergent herbicides is important.

Faba bean can be sown in wide rows, allowing non-selective weed control between the rows using shielded sprayers.

Pulse crops can be versatile if not used solely for grain harvest. Green or brown manure crops, hay cuts or grazing as standing crops are options that can be useful for managing resistant weeds. While there is no direct income from manuring it can achieve excellent grass-weed control, high nitrogen input, improved residual water carryover and better groundcover (for brown manuring). The large seed of faba and broad bean make them less attractive than smaller-seeded legumes to use as an intentional green or brown manure option.

5 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

1.2.2 Disease

Faba bean provides an important break for cereal root pests and diseases including cereal cyst nematode (CCN), take-all, crown rot and root-lesion nematode.

Grass weeds need to be controlled for the rotation to be effective. The rotation is one year for take-all and two years for crown rot and CCN. Faba bean is also a suitable rotational crop to reduce the incidence of root-lesion nematode.

1.2.3 Nitrogen

Pulses fix their own nitrogen (N), providing a boost for the following crops. Up to 40% of the nitrogen in a faba bean crop remains in the soil within the root system.

A vigorously growing crop with good nodulation and maximum biomass will fix more nitrogen. Nodulation and nitrogen fixation is suppressed when soil nitrate levels are already high. This means that there will be a greater benefit from pulses when soil nitrate is lacking. Studies in northern NSW showed that each tonne of shoot dry matter produced 19.3 kilograms of N per hectare.[6]

Using faba bean as a manure crop can increase the amount of nitrogen that is retained to benefit subsequent crops.

Faba bean is said to produce more nitrogen than other pulse crops because of its high dry matter production. However, it is more important to consider the soil type, as the pulse crop that will grow well will produce the most nitrogen in a given situation.

6 GRDC (2014) Nitrogen fixation fact sheet (southern and western regions). Grains Research and Development Corporation, http://www.grdc.com.au/GRDC-FS-NFixation-Legumes

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1.3 Key points for successfully growing faba bean

In the early days faba bean had a reputation for being difficult to grow and highly susceptible to foliar disease. However, an increased confidence in the profitability of this crop has resulted from:

- improved varieties with better regional adaption, higher yield potential and greater disease resistance;
- better disease management packages, including increased sprayer capacity and better short-term weather forecasts for fungicide application planning;
- improved farming systems;
- better crop management; and
- improved irrigation layouts.

Specific variety management packages (VMPs) are available from Pulse Australia to maximise the benefits from new improved pulse varieties.

Some disadvantages of faba bean in a rotation are:

- Unlike canola they do not have a deep root system capable of creating channels through the soil profile.
- They are susceptible to fungal diseases such as Ascochyta blight and chocolate spot. However, newer varieities with some resistance to these diseases now help when used with disease control strategies.
- They are moderately susceptible to hostile subsoils, such as those with high concentrations of boron, aluminium, sodicity and possibly salinity.

The key management practices for successful production of faba and broad bean are as follows:

- Avoid acid soils (or correct with lime) and light, sodic or saline soils, and those with boron toxicity.
- Plan weed management to reduce weed burden while also ensuring no residual herbicide carryover.
- Use good-quality seed with greater than 80% germination that is certified free from seed-borne Ascochyta pathogens.
- Test your sowing equipment with inoculated seed to ensure you can successfully sow the large flat bean.
- Sow into cereal stubble to maximise nitrogen fixation and minimise aphid infestation. Using wide rows can help improve stubble flow.
- Sow within the ideal sowing window. Sowing too early can lead to greater foliar disease incidence. Late-sown faba bean will have limited height and biomass and this will limit yield. Flowers may also be produced closer to the ground, making harvest difficult. Faba bean does not tolerate warm, dry finishes, so the length of the season will be shorter, limiting yield.
- Ensure good nutrition starting with seed inoculation to ensure effective nodulation. Apply phosphorus to deficient soils and, potentially, zinc on alkaline soils or molybdenum on acidic soils.
- Manage disease carefully. Understand the disease risks in your area and conduct a PreDicta®B soil test for nematodes. Choose resistant varieties where possible. Be prepared to apply preventative fungicides during the growing season, typically 2–4 applications at critical timings including post-emergence, prior to canopy closure and early pod-fill. Later sowing is a technique that can be used with caution to limit disease pressure in higher-rainfall areas. Use integrated disease management tools, such as planting more than 500 m from faba bean stubble and managing volunteers over summer.
- Control insects by managing the 'green bridge', using seed dressing and monitoring regularly for *Helicoverpa* caterpillars, which can damage pods during filling, making the seed unsuitable for human consumption markets.

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- Harvest on time, with a properly set-up header. Windrowing may assist with even ripening. Start when nearly all pods are black, but before stems become completely dry and black. If the header settings are correct, pods will thresh easily to yield clean, whole seeds with a minimum of splits and cracks.
- Have a marketing plan for on-farm storage or delivery options off-header. This may involve forward contracting if storage, pools or warehousing are not viable options.
- Optimise irrigation set-ups and timing. Faba bean respond well to irrigation in dry areas. Furrow irrigation is successful in southern irrigation areas with either pre-water and sow, or dry-sow and water-up. To maximise yield potential, crops should be watered to produce maximum biomass, and not allowed to stress during flowering and pod-fill.

When assessing the financial performance of bean crops in the rotation take a systems approach over several seasons to see the true benefits to the overall farming system.

1.4 Plant physiology

Faba bean plants are erect and up to 2 m tall at maturity, although most Australian crops are less than 1.5 m tall.

They produce branches stemming from the base. Leaves are compound, with only two leaflets in the early growth stages and up to seven leaflets after flowering begins.

The taproot penetrates to around 60 cm, with a profusion of fibrous roots. Overall, beans produce fewer roots and are shallower rooted than cereals and, given the shorter growing period, use relatively little soil moisture. However, this does make them more vulnerable to dry finishes.

Flowering begins from about the 5th to 7th node (joint) in early-maturing varieties and up to the 15th node or higher in later-maturing varieties. The flowers are in clusters (inflorescences) of 3–8 flowers (depending on the variety) in the axil (angle between leaf and stem) at each node. Inflorescences form in succession up the stem as each new node is produced over a 6–10-week period, or about 15 flowering nodes (Photo 1). Like many legumes, excess flowers are produced and fewer than 15% will develop into viable pods.

Photo 1: *Flowering faba bean.*

Photo: G Cumming, formerly Pulse Australia

Faba bean is predominantly self-pollinating; however, the introduction of honey bee hives has been shown to increase pollination rates and yields.

Flowering will finish when daylight temperatures approach 30°C, after which only a few leaf-bearing nodes are produced.

Pods in a well-grown crop are borne from about 20–30 cm above ground level. Each pod contains 2–4 seeds, which will vary in size depending on variety.

Bottom pods will mature first and turn black, as will the bottom leaves. This will continue gradually upwards as the plant senesces.

1.4.1 Suitable environments

Faba bean is a cool-season crop in Australia, planted in autumn and harvested in late spring to early summer. Faba bean is generally suited to the medium to high-rainfall areas with a minimum of 400 mm average annual rainfall or irrigation. Broad bean have a longer growing season and are more suited to the high-rainfall zone and a minimum of 450 mm.

The ideal soil type is a deep, well-drained loam. Clay soils are also suitable. Soil pH will ideally range from neutral to alkaline (pH in H_20 6.5–9.0, or pH in $CaCl_2$ 5.2–8.0). Faba and broad bean are moderately susceptible to hostile subsoils. Boron toxicity, sodicity and salinity can cause patchiness in affected paddocks. On acid soils, faba bean and broad bean are moderately susceptible to hostile manganese and aluminium toxicity, which can cause patchiness in affected paddocks.

The optimal temperature for plant growth is 15°C–20°C, especially during the reproductive phases of flower and pod development. Faba bean tolerate frost better than other pulses.

1.5 Products and uses

1.5.1 Human consumption

The most profitable use for pulses is the human consumption market. Faba bean and broad bean are a good source of carbohydrate and protein and are low in fat. Carbohydrate is mainly starch. The crude protein content of faba bean and broad bean ranges from 24–31%. They are also high in fibre.[7]

Faba bean and broad bean meet all adult human requirements for essential amino acids except methionine and tryptophan. They also provide the recommended daily allowance of all essential minerals except calcium.

Faba bean is exported as either whole or split product. It is generally consumed whole, canned, split and/or milled into flour. The main uses are:

- Cooked or baked – whole beans are used in soups, purées, baked goods, snack foods and breakfast foods, or can be cooked into a thick gruel.
- Ground – uncooked beans ground with other ingredients make falafel or tameya.
- Sprouts – sprouted for use in salads and stir-fries.
- Fresh – sold fresh in the pod or frozen.

1.5.2 Animal feed

Pulses are a valuable stockfeed due to their high protein levels and palatability, and can be used as part of intensive livestock rations or as supplements for paddock-reared stock.

Faba bean are used in the aquaculture, pig, poultry and horse industries as a source of protein as an alternative to field pea, fishmeal, lupin, soybean meal and other protein supplements.

7 Pulse Australia (2016) Health benefits of pulses. Pulse Australia, http://www.pulseaus.com.au/using-pulses/health-benefits

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Faba bean and broad bean are highly digestible and the metabolisable energy for pigs, poultry and ruminants is similar to lupin, field pea and soybean meal. They can correct the deficiencies in cereal stubbles or dry feed better than cereal grains. However, they are not as low in starch or as high in fibre as lupin, so they must be introduced gradually and fed regularly to avoid grain poisoning.

Bean crops may also be grazed where the crop has failed or as part of a strategy to control herbicide-resistant weeds.

Sheep and cattle can graze pulse stubbles, with the residual pulse grain of more value to livestock than cereal stubble. Faba bean produce excellent weight gain in sheep and cattle. Cattle are unable to pick up spilt seed from smaller pulses, but can manage faba and broad bean.

Be aware of any withholding periods or slaughter export intervals for chemicals used. Stocking rates can be estimated by calculating grain losses per hectare (see Section 12 Harvest). However, note that pulse stubbles are prone to erosion and grazing will increase the risk.

1.6 Market

The Australian faba and broad bean industry has grown steadily to now be one of the top five producers in the world. Australia is currently the world's leading exporter of faba bean, supplying one-third of faba bean traded internationally.

1.6.1 Faba bean

All faba bean grown in Australia is targeted at the human consumption markets. Our major buyers are the Middle Eastern countries including Egypt, Saudi Arabia and the United Arab Emirates. Some is split in Australia for human consumption.

International trade in faba bean of food quality is dominated by Egypt as the major importer, with several other countries importing smaller but still significant amounts.

The relatively small global market demand from the Middle East and Northern Africa is consistent and has been for the past 10 years. If there is a surplus of product produced globally prices will fall.

Producing a high-quality product with continuity of supply is important to maintain and increase access to faba bean markets into the future. Maintaining a light-tan seed colour and undamaged seed is essential (Photo 2).

Australia competes with France and the UK as the major exporters. In 2015, with historically high prices being paid globally for faba bean, the Baltic states, eastern Europe and North America entered the international faba bean market for the first time.

In the past, China was a major exporter but it is predicted to become a net importer in the future. Regulations need to be in place for Australian beans to be exported to China.

In addition, several countries are significant importers of faba and broad beans for livestock feed.

Faba bean not sold for human consumption is used by the Australian stockfeed industry, priced on a least-cost ration basis. This is mainly in the aquaculture, pig, poultry and horse industries. This grain is normally of a lower grade (discoloured) and/or damaged by insects or disease. Growers need to be prepared to store grain on-farm prior to selling into the stockfeed market.

Photo 2: *Faba bean products.*

Photo: *Faba beans: The Ute Guide (2009)*

1.6.2 Broad bean

Broad bean grown in Australia target the human consumption markets, as well as export stockfeed markets. Italy, Spain, Indonesia and Taiwan are the main importing countries for larger broad bean, while small broad bean are popular in Middle East countries such as Saudi Arabia, the United Arab Emirates, Jordan and Lebanon where they are used for canning.

Broad bean go into the whole-seed edible market, as well as stockfeed markets. Either way, there is a need for broad bean to be light and bright in colour and without weather damage. Size is critical and determines price.

Broad bean marketing is different to that of faba bean. There are few, if any, delivery points direct off-header, so on-farm storage is essential. Movement off-farm may not occur until spring, so there is often a long wait for sales, with cashflow implications for growers. Small broad bean can be hard to sell.

FEEDBACK

MORE INFORMATION

GroundCover™ TV: Pulse Breeding Australia retrospective:
https://youtu.be/TMmloC9gsm0

1.7 Faba bean research

The Australian faba bean breeding program aims to develop varieties that add value to the Australian cropping industry and meet the quality requirements of international markets. The program targets new varieties for either the southern region or the northern region (mainly northern NSW).

The breeding program began by introducing overseas varieties, but is now focused mainly on local crossing and selection, with a much reduced reliance on the introduction of new germplasm.

The early generations of the breeding cycle are undertaken at the University of Adelaide's Waite Campus, for the southern region, and the NSW Department of Primary Industries' Australian Cotton Research Institute (ACRI) in Narrabri for the northern region.

The main objectives of the breeding program are:

- to combine disease resistance and high yield potential in well-adapted backgrounds; and
- to introduce new sources of disease resistance, or other new traits of interest, to locally adapted material.

The breeding program is part of Pulse Breeding Australia (PBA), a world-class Australian breeding program delivering highly adapted chickpea, field pea, lentil, faba bean and lupin varieties to growers across Australia.

PBA has operated since 2006 and its vision is to see pulses expand to more than 15% of the cropping area so as to underpin the productivity, profitability and sustainability of Australian grain farming systems.

PBA's nationally coordinated breeding programs aim to deliver superior varieties to all Australian growing regions. PBA is an unincorporated joint venture between:

- Victorian Department of Economic Development, Jobs, Transport and Resources (DEDJTR)
- South Australian Research and Development Institute (SARDI)
- Queensland Department of Agriculture and Fisheries (DAF)
- New South Wales Department of Primary Industries (DPI)
- Department of Agriculture and Food, Western Australia (DPIRD)
- University of Adelaide
- University of Sydney
- Pulse Australia
- Grains Research and Development Corporation (GRDC)