Developed by Rural Solutions SA for the Grains Research and Development Corporation.

Published by Primary Industries and Resources South Australia.

© Primary Industries and Resources SA and Grains Research and Development Corporation 2009-04-04

Designed by PIRSA Publishing


Any recommendations, suggestions or options contained in this publication do not necessarily represent the policy or views of the Grains Research and Development Corporation. No person should act on the basis of the contents of this publication without first obtaining specific, independent professional advice. The Grains Research and Development Corporation will not be liable for any loss, damage, cost or expense incurred or arising by reason of any person using or relying on the information in this publication.

The Grains Research and Development Corporation owns the rights to the ‘Ute Guide’ series.
Authors
Tom Yeatman, Rural Solutions SA
Wayne Hawthorne, Pulse Australia
Jeff Paull, University of Adelaide
Judy Bellati, Jim Egan, Ken Henry, Rohan Kimber, South Australian Research and Development Institute
Mark Seymour, Department of Agriculture and Food Western Australia
Joop van Leur, Kurt Lindbeck, Peter Matthews, Ian Rose, New South Wales Department of Industry and Investment

Acknowledgements
The authors thank individuals and organisations who have contributed to the production of this publication. This publication was initiated and funded by the Grain Research and Development Corporation (GRDC). Text and images for this Guide have been adapted from the following publications and the contributions of those involved in those publications is gratefully acknowledged.

Winter Pulse Disorders: The Ute Guide (GRDC)
Crop Insects The Ute Guide, Southern Grain Belt Edition 2008 (GRDC)
Field Crop Herbicide Injury The Ute Guide (GRDC)
Grain Quality Winter Grain Crops The Ute Guide (GRDC)
Grain Legume Handbook 2008 edition
Faba Beans Variety Sowing Guide 2009 (SARDI)
Faba Bean in South Australia and Victoria (Pulse Australia, GRDC)
Faba Bean Disease Management Strategy for Southern and Northern Regions, (Pulse Australia, GRDC)
CONTENTS

Use of this guide .......................................... 7
Introduction .................................................. 8
Faba bean types and selection ............................ 9
Paddock selection and rotation ............................ 10
  Climate requirements .................................. 11
  Soil requirements ...................................... 12
  Irrigation .................................................. 13
Variety and seed selection ................................. 14
  Variety ....................................................... 14
  Seed quality .............................................. 15
Crop establishment ........................................ 16
  Sowing rate and plant density ....................... 17
  Time of sowing .......................................... 18
  Optimum sowing times for southern Australia 19
  Sowing depth ............................................ 20
  Wheel tracking .......................................... 20
  Row spacing ............................................. 21
  Inoculation ............................................... 22
  Rolling .................................................... 23
Crop development .......................................... 24
  Faba bean (Vicia faba) plant parts ................. 25
Symptom sorter ............................................. 26
Disease management ........................................ 28
  Infection sources that carryover major faba bean diseases ...... 29
  Group G ..................................................... 54
  Group I ..................................................... 55
  Group J ..................................................... 56
  Group K ..................................................... 57
  Group L ..................................................... 58
  Group M ..................................................... 59
  Chemical leaf spotting ................................ 60
  Avoiding and managing herbicide resistance .... 62
Nutrition management ...................................... 64
  Toxicity .................................................... 65
  Key to deficiencies in faba beans .................... 66
  Copper deficiency ..................................... 67
  Iron deficiency ......................................... 68
  Manganese deficiency .................................. 69
  Potassium deficiency .................................. 70
  Zinc deficiency ......................................... 71
  Nodulation failure ..................................... 72
Weather damage ........................................... 74
  Frost ....................................................... 74
  Hail ......................................................... 75
  Necking and lodging .................................. 76
  Waterlogging ............................................ 77
  Weather damaged grain ................................ 78
Insect pests ................................................... 79
  Aphids ..................................................... 79
  Moths and caterpillars ................................. 82
  Flies ....................................................... 88
  Mites ....................................................... 89
Disease prediction to assist disease risk management ........................................ 29
Faba bean diseases and potential for cross infection from other pulses ........ 30
Fungicide guide ....................................................... 31
Fungicide spraying program .......................................... 32
Aphanomyces root rot ............................................... 33
Ascochyta blight .................................................... 34
Cercospora leaf spot ................................................ 35
Chocolate spot ...................................................... 36
Downy mildew ...................................................... 38
Root rots .......................................................... 39
Rust ................................................................. 40
Sclerotinia stem rot .................................................. 41
Stem nematode ..................................................... 42
Controlling viruses .................................................. 43
Mosaic viruses ....................................................... 44
Yellowing viruses ..................................................... 45

**Weed management** ...................................... 46
Effective weed control ................................................. 47
Avoiding herbicide damage ......................................... 48
Herbicide injury ..................................................... 49
Herbicide damage effects and symptoms in faba beans ..................... 50
Group B .......................................................... 50
Group C .......................................................... 51
Group D .......................................................... 52
Group F .......................................................... 53

Springtails .......................................................... 94
Thrips .............................................................. 95
Beetles ............................................................. 96

**Beneficial organisms** ........................................... 97

**Slugs and snails** .................................................. 102

**Other disorders** ................................................ 108
Oedemas .......................................................... 108
Salinity .......................................................... 109

**Pollination** ....................................................... 110

**Harvesting** ........................................................ 112
Desiccation and crop topping ........................................ 112
Weed wiping ....................................................... 113
Windrowing ......................................................... 113
Harvest timing ...................................................... 114
Tips for harvesting ................................................ 115
Harvest for quality ................................................ 116
Harvesting for seed ................................................. 116

**Marketing** ........................................................ 118
Faba and broad bean market categories ........................................... 119
National faba and broad bean market receiveal standards .................. 120
Defective grain ..................................................... 121
Commercial buying and selling arrangements ................................ 122

**Handling and storage** ............................................. 123

**Index** ............................................................. 124
ABBREVIATIONS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CESAR</td>
<td>Centre for Environmental Stress and Adaptation Research</td>
</tr>
<tr>
<td>DAFWA</td>
<td>Department of Agriculture and Food, Western Australia</td>
</tr>
<tr>
<td>GRDC</td>
<td>Grains Research and Development Corporation</td>
</tr>
<tr>
<td>NSW DII</td>
<td>New South Wales Department of Industry and Investment</td>
</tr>
<tr>
<td>PaDIL</td>
<td>Pest and Disease Image Library, Museum Victoria</td>
</tr>
<tr>
<td>QPIF</td>
<td>Queensland Primary Industries and Fisheries</td>
</tr>
<tr>
<td>SARDI</td>
<td>South Australian Research and Development Institute</td>
</tr>
<tr>
<td>VDPI</td>
<td>Victorian Department of Primary Industries</td>
</tr>
</tbody>
</table>

*Image: W Hawthorne, Pulse Australia*
This guide is designed to assist in the recognition of symptoms including those of disease, insect attack and poor nutrition in faba bean crops, as well as identifying critical issues of best practice in growing and marketing the crop.

Abnormal symptoms that are identified in the crop can indicate a physical, nutritional, chemical or disease caused disorder, which can be initially identified using the Symptom Sorter on Page 26 of this guide. The appropriate section of the guide is indicated to seek further clarification and direction as to best practice to manage or avoid the disorder in the future.

It should be noted that varieties and products mentioned in this guide are those available and registered at May 2009 and may change over time.

A well grown faba bean crop with good yield potential.

Image: W Hawthorne, Pulse Australia
INTRODUCTION

Faba and broad beans (*Vicia faba*) are vigorous pulse crops with high yields and lucrative prices. Bean types differ in seed size, shape and colour, and include the small seeded faba bean from 35–100 g per 100 seeds. Broad beans are much larger, ranging from 100–200 g per 100 seeds and require a long growing season to fill grains. They meet different market requirements to faba beans and are sold graded to size. The more rounded horse or tic beans are virtually not grown in Australia.

With correct paddock selection and good management faba beans can give higher yields than all other pulses. The crop needs to be well managed to ensure food grades are achieved. Bean quality is critical for human food markets.

Fungal diseases like chocolate spot, ascochyta blight and rust have devastated faba bean crops in the past, but with new varieties and fungicides, control strategies are quite manageable. A disease control strategy based on variety and paddock selection and strategic use of fungicide sprays is essential.

The large-seeded broad bean is well adapted to higher rainfall areas because of its higher yield potential, better disease resistance and waterlogging tolerance, and higher prices.

*Image: M Ramsey, formerly SARDI*
There are several different types of beans (*Vicia faba*) based on their seed size and shape.

Faba beans are most commonly grown in southern and northern Australia.

**SIZE CATEGORIES**

- Small (faba bean)
- Medium (faba bean)
- Large (faba bean)
- Very large (broad bean)

**Images:** T Yeatman, Rural Solutions SA; W Hawthorne, Pulse Australia

---

**FABA BEAN TYPES AND SELECTION**
Paddock selection

Faba beans grow well sown after cereal or oilseed crops with plenty of surface stubble cover. They provide large benefits to the following crop through a cereal disease break, residual moisture and contributing to soil nitrogen, which is more likely when the crop has a large biomass or the soil was initially low in nitrogen.

Self-sown faba beans from carry-over of hard seed can cause admixture quality problems. The larger seed of broad bean is less likely to cause a contamination problem.

Bean stubble residues are bulky and provide protection when retained to the soil after harvest. Spilt grain provides an excellent feed source for stock.

Minimise disease build-up with at least a four year break between bean crops. Reduce risk of disease by not sowing adjacent to bean, vetch or lentil stubbles. Be aware of herbicide residues and plant-back requirements in the rotation, especially after drought conditions.

Greener wheat after beans outside, and yellower wheat after peas in the centre of the paddock.
Climate requirements

**Rainfall:** Faba beans are best suited to the medium rainfall areas (400–600 mm average annual rainfall) or cropping regions with irrigation. They have been successful in lower rainfall areas (350 mm) where sown early and rainfall is winter dominant. Broad beans require more than 500 mm rainfall.

**Temperatures:** Beans are more tolerant of frost during podding than other pulses. Frost can cause stem weakness leading to lodging and loss of flowers or tillers. Beans are very sensitive to hot dry conditions during flowering and podding. Early sowing reduces this risk. Flowers may abort when temperatures exceed 27°C.

Images: W Hawthorne, Pulse Australia

A well grown faba bean crop setting pods in mild spring conditions with adequate soil moisture.

Faba beans are ideally suited to well drained higher rainfall areas.
Soil requirements

Faba beans grow best on deeper clay loam soils with high water holding capacity but also suit red-brown earths, black earths, grey clays and alluvial loams. Beans are very susceptible to hardpans and soils that dry quickly. Beans yield best in well-drained soils, but are the most tolerant pulse to waterlogging. Broad beans are slightly more tolerant of waterlogging.

Soil pH should be from slightly acid to alkaline ($\text{pH}_{\text{CaCl}_2} 5.8 - 8.2$; $\text{pH}_{\text{water}} 6.5$ to $9.0$). On acidic soils ($\text{pH}_{\text{water}} < 6$) beans often nodulate poorly. Use of granular inoculant and lime application may make some acidic soils suitable for growing beans. Foliar nutrients (Fe, Mn, Zn) may need to be applied on highly alkaline soils ($\text{pH}_{\text{water}} > 8$). Good yields have come from paddocks with $\text{pH}_{\text{CaCl}_2}$ as low as 4.6 where aluminium and manganese levels were low (aluminium below 20 µg/g and/or manganese below 50 µg/g).

Root growth may be poor in hard setting soils and soils susceptible to hard pans and compact sub-soils, highly acidic or alkaline subsoils or saline soils, reducing crop growth and drought tolerance. Stony and uneven soils create harvest difficulties where shorter crops.

Soil requirements

Images: T Yeatman, Rural Solutions SA; W Hawthorne, Pulse Australia
Irrigation

Faba bean can be successfully grown under irrigation. Consider raised beds if drainage is poor. Minimise irrigation times to prevent waterlogging.

Effective drainage is a combination of surface and soil drainage. Improve surface drainage with large capacity drains with good outfall, laser-levelling, smoothed bays, and raised beds or spinner cuts. Soil drainage can be improved with gypsum where appropriate. Minimising cultivation, particularly of dry soil, can help to preserve soil structure and drainage.

Prolonged waterlogging will reduce yields. Pre-irrigation and sowing into moisture is preferred, as is watering dry sown crops. Apply the first spring irrigation early enough to ensure that dry roots do not hasten the end of flowering and severely affect yield. This irrigation often coincides with the “reproductive phase” during maximum flowering and some pod filling.

Irrigated crops often lodge but this does not necessarily affect yield if disease is controlled.
Variety

Consider markets, yield, disease reaction and maturity, along with lodging and shattering resistance. Be aware of the necessity to segregate and market on type and variety. Some types attract a price premium, which may vary year to year.

Fiesta VF is currently the most widely grown faba bean variety in the southern region. Ascochyta resistant Farah\(^\text{a}\) is being increasingly grown. Nura\(^\text{b}\) has ascochyta, chocolate spot and rust resistance and is increasing in area. Broad beans are more a specialty crop.

Cairo\(^\text{b}\) is the most widely grown faba bean variety in the northern region, having rust and frost resistance. Doza\(^\text{a}\) is an early flowering release steadily replacing Cairo\(^\text{b}\) in the north.

See the specific Variety Management Packages (VMPs) for each new variety to determine suitability to your farming system.

<table>
<thead>
<tr>
<th>Variety</th>
<th>Maturity</th>
<th>Seed colour</th>
<th>Seed size g/100 seeds</th>
<th>Height</th>
<th>Ascochyta blight</th>
<th>Chocolate spot</th>
<th>Cercospera</th>
<th>Rust</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aquadulce</td>
<td>Late</td>
<td>Light brown – brown</td>
<td>100–160</td>
<td>Tall</td>
<td>MS</td>
<td>MS</td>
<td>S</td>
<td>MS</td>
</tr>
<tr>
<td>Ascot VF</td>
<td>Early</td>
<td>Light brown – brown</td>
<td>35–55</td>
<td>Short</td>
<td>R</td>
<td>VS</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>Cairo(^\text{b})</td>
<td>Early</td>
<td>Light brown – brown</td>
<td>55–75</td>
<td>Medium-tall</td>
<td>VS</td>
<td>VS</td>
<td>S</td>
<td>MR–R</td>
</tr>
<tr>
<td>Doza(^\text{a})</td>
<td>Early</td>
<td>Buff</td>
<td>35–55</td>
<td>Medium</td>
<td>VS</td>
<td>S</td>
<td>S</td>
<td>R</td>
</tr>
<tr>
<td>Farah(^\text{b})</td>
<td>Early–Mid</td>
<td>Light brown – brown</td>
<td>55–75</td>
<td>Medium</td>
<td>MR–R</td>
<td>S</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>Fiesta VF</td>
<td>Early–Mid</td>
<td>Light brown – brown</td>
<td>55–75</td>
<td>Medium</td>
<td>MS–MR</td>
<td>S</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>Fiord</td>
<td>Early</td>
<td>Light brown – brown</td>
<td>35–55</td>
<td>Short</td>
<td>MS</td>
<td>VS</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>Manafest</td>
<td>Mid</td>
<td>Light brown</td>
<td>88–100</td>
<td>Medium(^\text{b})</td>
<td>VS</td>
<td>MS</td>
<td>S</td>
<td>MS</td>
</tr>
<tr>
<td>Nura(^\text{b})</td>
<td>Early–Mid</td>
<td>Light buff</td>
<td>50–70</td>
<td>Short</td>
<td>MR–R</td>
<td>MS–MR</td>
<td>S</td>
<td>MR</td>
</tr>
</tbody>
</table>

R = resistant; MR = moderately resistant; MS = moderately susceptible; S = susceptible; VS = very susceptible
Seed quality

Quality seed is vital for crop establishment. Check germination percentage and purity before purchasing seed and ask for the test certificate. Germination test retained seed and adjust seeding rates for the desired plant density. Grade to ensure seed is free from weed and crop seed contamination.

Use seed with less than 10% chocolate spot or 5% ascochyta infection, preferably with nil infection. Seed disease testing services are available. Seed-borne inoculum is usually less important than stubble-borne inoculum. Ensure a minimum distance of 400 m from other varieties to reduce the risk of cross-pollination, especially if the crop is to be used for seed.

Weathering of crops after ripening and poor storage can substantially reduce germinability of seed. Germination and vigour may deteriorate in storage if seed is more than one year old, frosted or weather damaged. Good seedling vigour is as important as seed viability and may reduce susceptibility to seedling disease.

Retain seed from the healthiest crop where disease levels are lowest. Avoid sowing small graded seed, as this may reduce early vigour and height, and shift to smaller grain type.

Sowing quality seed is the first step to ensuring a profitable crop.

*Image: W Hawthorne, Pulse Australia*
CROP ESTABLISHMENT

Most conventional cereal equipment will sow faba beans but broad beans may need special seeding mechanisms and wide tubes to avoid bridging in the seed box or blocked tubes.

Sowing before the seasonal break has the advantage of establishing crops early if rain is timely. Dry sowing is common in districts where growers want to sow beans early in their cropping program. Beans are well suited to no-till, reduced tillage and stubble retention systems. Sow into friable soil ensuring good seed-to-soil contact. The larger seed of beans helps ensure good seed-to-soil contact and emergence. Exposed seed may not germinate.

The surface retention of cereal stubble does not affect bean germination or growth, and may improve establishment on hard-setting, surface-crusting soils. It is important to keep adequate plant residue on the surface to protect the soil from moisture loss and erosion during growth and after harvest.

Images: W Hawthorne, Pulse Australia; T Yeatman, Rural Solutions SA

Variable establishment and rates of early growth are likely to hamper management and yield.

Good even establishment in standing stubble which will help prevent loss of moisture.
Sowing rate and plant density

Lower plant populations may reduce the risk of foliar disease but lower seeding rates can result in reduced grain yield. Sown headlands can exacerbate disease development. Use lower plant densities with early sowing and larger seeded varieties; higher if later sowing small seeded varieties or on hard setting soils with poor surface structure to allow for poorer emergence. Seeding rates may be reduced by up to 20% in wide rows (>36 cm) or in high rainfall areas to reduce foliar disease pressure.

Target plant populations (plants/m²).

<table>
<thead>
<tr>
<th>Region</th>
<th>Small faba (35–50g/100 seeds)</th>
<th>Medium faba (50–75g/100 seeds)</th>
<th>Large faba (75–90g/100 seeds)</th>
<th>Broad bean (100–160g/100 seeds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SA/Vic</td>
<td>25–35</td>
<td>20–35</td>
<td>20–25</td>
<td>8–15</td>
</tr>
<tr>
<td>Northern NSW</td>
<td>15–25</td>
<td>15–25</td>
<td>15–25</td>
<td>–</td>
</tr>
<tr>
<td>Southern NSW</td>
<td>20–35</td>
<td>20–35</td>
<td>20–35</td>
<td>–</td>
</tr>
<tr>
<td>Irrigated NSW</td>
<td>15–30</td>
<td>15–30</td>
<td>15–30</td>
<td>8–15</td>
</tr>
<tr>
<td>WA</td>
<td>40–45</td>
<td>30–35</td>
<td>–</td>
<td>20</td>
</tr>
</tbody>
</table>

Faba bean sowing rates (kg/ha) for target plant populations (80% emergence).

<table>
<thead>
<tr>
<th>Plant density (plants/m²)</th>
<th>Small 50 g/100 seeds</th>
<th>Medium 70 g/100 seeds</th>
<th>Large 90 g/100 seeds</th>
<th>Small 100 g/100 seeds</th>
<th>Medium 140 g/100 seeds</th>
<th>Large 160 g/100 seeds</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>90</td>
<td>125</td>
<td>140</td>
</tr>
<tr>
<td>12</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>130</td>
<td>185</td>
<td>210</td>
</tr>
<tr>
<td>20</td>
<td>110</td>
<td>155</td>
<td>200</td>
<td>220</td>
<td>310</td>
<td>350</td>
</tr>
<tr>
<td>30</td>
<td>165</td>
<td>230</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>40</td>
<td>220</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>

Use the formula:

Seeding rate (kg/ha) =
Plant density (plants/m²) x 1000 seed wt (g) ÷ Emergence percentage⁺.

⁺NOTE: The number of seeds that emerge is often less than the seeds sown due to non-viable seed, seedlings with poor vigour, disease, herbicide damage or poor soil structure.
CROP ESTABLISHMENT

Time of sowing

Time of sowing is important for management of bean disease and maximum yield. A yield decrease of 150–250 kg/ha is likely every week past the optimum sowing time. Early sowing may result in a bulky crop conducive to foliar disease, particularly chocolate spot and ascochyta blight, as well as poor early pod set. Pods of earlier sown beans are higher above ground level. Later sowings reduce disease risk but increase risk of reduced yield from dry conditions and high temperatures at flowering to pod fill.

Optimum sowing time for faba beans is late April to mid May in the 400–550 mm rainfall zone, and mid May to early June in the 550–650 mm areas. Early sown crops have the highest yield potential, but require greater canopy management or disease control measures. Wider rows and lower seeding rates can assist.

Early sowing in many areas ensures yield potential but can increase canopies and disease susceptibility.

Image: W Hawthorne, Pulse Australia
## Optimum sowing times for southern Australia

<table>
<thead>
<tr>
<th>Region (annual rainfall)</th>
<th>Month</th>
<th>April</th>
<th>May</th>
<th>June</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Week</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>SA and VIC less than 350 mm</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SA and VIC 350–450 mm</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SA and VIC 450–550 mm</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SA and VIC 550–650 mm</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SA and VIC greater than 650 mm</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SA and VIC irrigation (less than 350 mm)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NSW southern (Temora-Wagga-Lockart)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NSW southern irrigated (Griffith-Hillston)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NSW central (Cowra-Forbes)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NSW central (Dubbo-Warren)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NSW northern (Narrabri-Boggabilla)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NSW northern (Walgett-Coonamble)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NSW northern (Liverpool Plains)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WA (low rainfall)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WA (medium rainfall)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WA (high rainfall)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Marginal areas or low disease risk areas
- Preferred planting time
- For high disease risk areas
Sowing depth

Faba and broad beans are best sown 5–8 cm deep. Faba bean cotyledons remain below the soil surface and only the shoot pushes through. They are capable of emerging from deeper than 10 cm. Shallow sown faba bean are more prone to damage by herbicide, produce fewer lateral roots and may also be more prone to lodging.

Sow at 8–10 cm when dry sowing to ensure good moisture conditions before germination and to protect the inoculum from high temperatures near the soil surface. If the opening rains are delayed some weeks, deep sown crops can be very slow to establish when soil temperatures fall.

Wheel tracking

Row placement can be important. Consider ‘tram lining’ and controlled traffic to avoid physical damage to the crop from machinery that provides potential ‘hotspots’ for disease.

Images: M Seymour, DAFWA; W Hawthorne, Pulse Australia
Row spacing

Row spacing varies from 15 to 100 cm. Wide rows (>50 cm) are more common in northern bean areas, but are also becoming more prevalent in southern areas. They provide better canopy management and increase confidence in sowing beans early. Wider row spacing (> 25 to 36 cm) suits stubble clearance, can enable better weed control, improves light penetration through the canopy and allows more air movement between the rows to assist pollination and pod set, as well as lessen the impact of leaf disease.

The height of the lowest pods is increased with wider row spacings or with higher seeding rates. Weed control can be worse with wider row spacing unless no-till is used, stubble is present and controls have occurred in the previous year. Shielded sprayers can be used with very wide rows.

Faba beans sown on wider rows yielded significantly more in SA trials (2006).

Images: W Hawthorne, Pulse Australia
Inoculation

Faba beans require the Group F rhizobium (Group E can be used if necessary). Inoculant can be applied either on seed, in-furrow by water injection or in granular form. Inoculate every time they are sown in waterlogged and acidic soils, particularly on poorly structured red brown earths and in colder, wetter areas where conditions for survival of rhizobia are poor.

In established pea and bean growing districts inoculation may not be essential if peas, lentils or vetches have been grown during the past five years. Alkaline, self-mulching grey clays maintain high numbers of suitable rhizobia to ensure good nodulation without seed inoculation.

Use of fungal seed dressing is seldom beneficial. Thiram + thiabendazole is registered in faba beans for seedling root rots (*Fusarium* spp. and *Pythium* spp.). It can minimise the risk of introduction of disease into new bean areas. Apply the seed dressing first and then inoculate immediately before seeding. Do not mix inoculants and seed dressing together unless the inoculant label specifies compatibility.

Preferably do not use fungicide seed dressings on acid soils as maximum numbers of rhizobia are needed. Granular and other forms of inoculum may assist in rhizobial survival, particularly in acid soils or when sown dry.

(Right) Peat inoculum can be applied with a low pressure applicator into the auger which then mixes the inoculant and seed.

(Left) Green inoculated pots right compared to yellow uninoculated plots left.

Images: P Munns, Time Saver Industries; W Hawthorne, Pulse Australia
Rolling

Surface rolling or prickle chaining flattens clods and ridges caused by sowing or press wheels and presses rocks and sticks into the soil leaving a flat surface. This allows the header comb to pick up the lowest bean pods at harvest. This reduces harvest losses, harvester wear and contamination in the seed sample. Rolling is best done with a rubber tyred roller, with moist soil that is not too wet or dry.

Rolling should be carried out post-sowing pre-emergence. It may have to be delayed until the crop has emerged if the soil is prone to hard setting, crusting or eroding on sandy or sloping country. Emerging shoots can be broken off if rolling when plants are just emerging.

If rolling post-emergence, do it in warm conditions of an afternoon or a warmer day when plants are limp and not brittle from cold or frosty conditions. Avoid rolling two weeks before or after applying a post-emergent herbicide. Rolling beans post-emergence could increase the possibility of leaf diseases early, aiding the early spread of disease later within the crop.
<table>
<thead>
<tr>
<th>Development phase</th>
<th>Growth stage (GS)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>00 Germination</strong></td>
<td>GS 000 Dry seed&lt;br&gt;GS 001 Imbibed seed&lt;br&gt;GS 002 Radicle apparent&lt;br&gt;GS 003 Plumule and radicle apparent&lt;br&gt;GS 004 Emergence&lt;br&gt;GS 005 First leaf unfolding&lt;br&gt;GS 006 First leaf unfolded</td>
<td>First leaf fully unfolded with one pair leaflets&lt;br&gt;X leaf fully unfolded with more than one pair of leaflet&lt;br&gt;N – any number of nodes on the main stem with fully unfolded leaves according to cultivar&lt;br&gt;Seeds rubbery, pods still pliable turning black&lt;br&gt;Pods dry and black, seed dry and hard</td>
</tr>
<tr>
<td><strong>10 Vegetative</strong></td>
<td>GS 101 First node&lt;br&gt;GS 10(X) X node&lt;br&gt;GS1(N) N, Last recorded node</td>
<td>First leaf fully unfolded with one pair leaflets&lt;br&gt;X leaf fully unfolded with more than one pair of leaflet&lt;br&gt;N – any number of nodes on the main stem with fully unfolded leaves according to cultivar&lt;br&gt;Seeds rubbery, pods still pliable turning black&lt;br&gt;Pods dry and black, seed dry and hard</td>
</tr>
<tr>
<td><strong>20 Reproductive</strong></td>
<td>GS 201 Flower buds visible&lt;br&gt;GS 203 First open flower&lt;br&gt;GS 204 Pod set&lt;br&gt;GS 205 Green pods fully formed&lt;br&gt;GS 207 Pod fill&lt;br&gt;GS 209&lt;br&gt;GS 210 Dry seed</td>
<td>First buds visible and still green&lt;br&gt;First open flowers on fist raceme&lt;br&gt;First pods visible at first fertile node&lt;br&gt;Small immature seeds within&lt;br&gt;Seeds maximum size fill pod cavity&lt;br&gt;Seeds rubbery, pods still pliable turning black&lt;br&gt;Pods dry and black, seed dry and hard</td>
</tr>
<tr>
<td><strong>30 Senescence</strong></td>
<td>GS 301 10% pods dry and black&lt;br&gt;GS 305 50% pods dry and black&lt;br&gt;GS 308 80% pods dry and black, some upper pods green&lt;br&gt;GS 309 90% pods dry and black, desiccation stage&lt;br&gt;GS 310 All pods dry and black, seed hard</td>
<td>Pods dry and black, seed dry and hard</td>
</tr>
<tr>
<td><strong>40 Stem senescence</strong></td>
<td>GS 401 10% stem brown/black or most stem green&lt;br&gt;GS 405 50% stem brown/black or 50% stem green&lt;br&gt;GS 410 All stems brown/black, all pods dry and black, seed hard</td>
<td>Pods dry and black, seed dry and hard</td>
</tr>
</tbody>
</table>

(The Processors and Growers Research Organisation, UK)
Nodes are counted from the point at which the first true leaves are attached to the stem.

<table>
<thead>
<tr>
<th>Description</th>
<th>Crop affect</th>
<th>Plant symptoms</th>
<th>Disorder</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scattered plants</td>
<td>Wilting</td>
<td>Premature death</td>
<td>Sclerotinia rot</td>
<td>42</td>
</tr>
<tr>
<td></td>
<td>Yellow/Pale green</td>
<td>Leaves distorted</td>
<td>Mosaic viruses</td>
<td>45</td>
</tr>
<tr>
<td></td>
<td>Stunted</td>
<td>Premature death</td>
<td>Yellowing viruses</td>
<td>44</td>
</tr>
<tr>
<td>Patches</td>
<td>Poor emergence</td>
<td>Plants chewed</td>
<td>Mouse damage</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Snails</td>
<td>104</td>
</tr>
<tr>
<td></td>
<td>Brown/grey</td>
<td>Stem and leaf spotting</td>
<td>Red-legged earth mite</td>
<td>92</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Chocolate spot</td>
<td>38</td>
</tr>
<tr>
<td></td>
<td>Yellow/red</td>
<td>Stunted</td>
<td>Root rots</td>
<td>41</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Dodder</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Premature death</td>
<td>Root and crown rot</td>
<td>41</td>
</tr>
<tr>
<td></td>
<td>Pale green</td>
<td>Leaf and pod spotting</td>
<td>Thrips</td>
<td>95</td>
</tr>
<tr>
<td></td>
<td>Stunted</td>
<td>Leaves/stem distorted</td>
<td>Stem nematode</td>
<td>44</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Mites (seedlings)</td>
<td>89</td>
</tr>
<tr>
<td></td>
<td>Wilting</td>
<td>Leaves distorted</td>
<td>Cow pea aphid</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td>Physically damaged</td>
<td>Stems, leaves and pods</td>
<td>Mouse damage</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Bird/hare damage</td>
<td>–</td>
</tr>
<tr>
<td>Highly alkaline soil</td>
<td>Yellowing</td>
<td>Young leaves yellow</td>
<td>Iron deficiency</td>
<td>68</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Tip death</td>
<td>69</td>
</tr>
<tr>
<td></td>
<td>Patches</td>
<td>Plants chewed</td>
<td>Snails</td>
<td>104</td>
</tr>
<tr>
<td></td>
<td>Stunted</td>
<td>Black leaf edges</td>
<td>Group B herbicide damage</td>
<td>50</td>
</tr>
<tr>
<td>Acidic soil</td>
<td>Yellow/orot</td>
<td>Stunted</td>
<td>Nodulation failure</td>
<td>72</td>
</tr>
<tr>
<td>Low lying areas</td>
<td>Grey</td>
<td>Black leaf edges</td>
<td>Frost</td>
<td></td>
</tr>
<tr>
<td>---------------------------------------</td>
<td>-----------------------</td>
<td>------------------------</td>
<td>----------------------------</td>
<td>------------</td>
</tr>
<tr>
<td>Yellow/red</td>
<td>Grey</td>
<td>Black leaf edges</td>
<td>Frost</td>
<td></td>
</tr>
<tr>
<td>Yellow/red</td>
<td>Grey</td>
<td>Black leaf edges</td>
<td>Frost</td>
<td></td>
</tr>
<tr>
<td>General</td>
<td>Poor emergence</td>
<td>Tip death</td>
<td>Seed sown too deep</td>
<td>20</td>
</tr>
<tr>
<td>Poor emergence</td>
<td>Stunted</td>
<td>Tip death</td>
<td>Seed sown too deep</td>
<td>20</td>
</tr>
<tr>
<td>Stunted</td>
<td>Young leaves yellow</td>
<td>Group F herbicide damage</td>
<td>53</td>
<td></td>
</tr>
<tr>
<td>Leaf spotting</td>
<td>Zinc deficiency</td>
<td>Group F herbicide damage</td>
<td>53</td>
<td></td>
</tr>
<tr>
<td>Leaves distorted</td>
<td>Clopyralid herbicide damage</td>
<td>55</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pale green</td>
<td>Leaves distorted</td>
<td>Group M herbicide damage</td>
<td>59</td>
<td></td>
</tr>
<tr>
<td>Pale green</td>
<td>Leaves distorted</td>
<td>Group M herbicide damage</td>
<td>59</td>
<td></td>
</tr>
<tr>
<td>Yellow/red</td>
<td>Tip death</td>
<td>Boron toxicity</td>
<td>65</td>
<td></td>
</tr>
<tr>
<td>Yellow/red</td>
<td>Tip death</td>
<td>Boron toxicity</td>
<td>65</td>
<td></td>
</tr>
<tr>
<td>Grey/brown</td>
<td>Leaf spotting</td>
<td>Ascochyta blight</td>
<td>36</td>
<td></td>
</tr>
<tr>
<td>Grey/brown</td>
<td>Leaf spotting</td>
<td>Ascochyta blight</td>
<td>36</td>
<td></td>
</tr>
<tr>
<td>Grey/brown</td>
<td>Leaf spotting</td>
<td>Chocolate spot</td>
<td>38</td>
<td></td>
</tr>
<tr>
<td>Grey/brown</td>
<td>Leaf spotting</td>
<td>Chocolate spot</td>
<td>38</td>
<td></td>
</tr>
<tr>
<td>Grey/brown</td>
<td>Leaf spotting</td>
<td>Rust</td>
<td>42</td>
<td></td>
</tr>
<tr>
<td>Grey/brown</td>
<td>Leaf spotting</td>
<td>Rust</td>
<td>42</td>
<td></td>
</tr>
<tr>
<td>Grey/brown</td>
<td>Leaf spotting</td>
<td>Cercospera</td>
<td>37</td>
<td></td>
</tr>
<tr>
<td>Grey/brown</td>
<td>Leaf spotting</td>
<td>Cercospera</td>
<td>37</td>
<td></td>
</tr>
<tr>
<td>Grey/brown</td>
<td>Leaf spotting</td>
<td>Hail</td>
<td>76</td>
<td></td>
</tr>
<tr>
<td>Grey/brown</td>
<td>Leaf spotting</td>
<td>Hail</td>
<td>76</td>
<td></td>
</tr>
<tr>
<td>Physically damaged</td>
<td>Leaf, stem and pods damaged</td>
<td>Triazine herbicide</td>
<td>51</td>
<td></td>
</tr>
<tr>
<td>None obvious</td>
<td>Pods chewed</td>
<td>Native budworm</td>
<td>86</td>
<td></td>
</tr>
<tr>
<td>None obvious</td>
<td>Pods chewed</td>
<td>Native budworm</td>
<td>86</td>
<td></td>
</tr>
<tr>
<td>Pod splitting</td>
<td>Oedemas</td>
<td>Oedemas</td>
<td>109</td>
<td></td>
</tr>
<tr>
<td>Pod splitting</td>
<td>Oedemas</td>
<td>Oedemas</td>
<td>109</td>
<td></td>
</tr>
</tbody>
</table>
Effective disease management relies on selection of a variety with the most suitable profile of disease resistance, most suitable paddock, clean seed, best agronomic practices and canopy management, as well as the use of fungicides. Damage to the crop from machinery can be a major cause of disease or poor grain quality. Consider ‘tram lining’ and controlled traffic.

<table>
<thead>
<tr>
<th>Factor</th>
<th>Best practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paddock history</td>
<td>A minimum four year break between bean crops.</td>
</tr>
<tr>
<td>Paddock hygiene</td>
<td>Select paddocks at least 500 m from last year’s crop stubble. Avoid sowing adjacent to bean, vetch or lentil stubbles.</td>
</tr>
<tr>
<td>Variety</td>
<td>Select a variety with suitable disease resistance for your district.</td>
</tr>
<tr>
<td>Seed health</td>
<td>Use seed from crops that were disease free, especially at podding. Laboratory seed tests can confirm disease levels. Use seed with less than 10% chocolate spot or 5% <em>Ascochyta</em>.</td>
</tr>
<tr>
<td>Sowing time</td>
<td>Minimise the risk of foliar disease due to excessive vegetative growth. Do not sow too early. Early emergence leads to early exposure to disease and early canopy closure, increasing development of foliar disease.</td>
</tr>
<tr>
<td>Sowing rate</td>
<td>Higher than ideal seeding rates and plant populations lead to a dense crop canopy and increased disease risk.</td>
</tr>
<tr>
<td>Row spacing</td>
<td>Wider rows can delay canopy closure, reducing the risk of chocolate spot. Any increased lodging may increase the chance of foliar disease.</td>
</tr>
<tr>
<td>Fungicide application</td>
<td>Success is dependant on monitoring, correct disease identification, coverage and timeliness of sprays with the correct fungicide.</td>
</tr>
<tr>
<td>Seed</td>
<td>Reduce transmission of disease with thiram + thiabendazole application (helps control <em>Ascochyta</em>, <em>Botrytis</em> and seedling root rots).</td>
</tr>
<tr>
<td>Foliar</td>
<td>Most effective when applied before or at first signs of disease before rain. Protection lasts 10–12 days. Subsequent new growth is unprotected.</td>
</tr>
<tr>
<td>Aphid control</td>
<td>Early detection and control can reduce virus spread. Summer weed control, crop density, stubble and minimal bare soil become important in reducing the presence of aphids.</td>
</tr>
<tr>
<td>Harvest management</td>
<td>Early harvest reduces disease infection on the seed. Windrow or desiccate to enable earlier harvest.</td>
</tr>
</tbody>
</table>
### Infection sources that carryover major faba bean diseases

<table>
<thead>
<tr>
<th>Disease</th>
<th>Stubble</th>
<th>Seed</th>
<th>Soil</th>
<th>Aphids</th>
<th>Volunteers over summer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ascochyta blight</td>
<td>***</td>
<td>**</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Chocolate spot</td>
<td>***</td>
<td>*</td>
<td>*</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Cercospora leaf spot</td>
<td>**</td>
<td>–</td>
<td>***</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Rust</td>
<td>**</td>
<td>–</td>
<td>*</td>
<td>–</td>
<td>***</td>
</tr>
<tr>
<td>Seed-borne viruses</td>
<td>–</td>
<td>**</td>
<td>–</td>
<td>***</td>
<td>***</td>
</tr>
<tr>
<td>Non-seed-borne viruses</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>***</td>
<td>***</td>
</tr>
</tbody>
</table>

### Disease prediction to assist disease risk management

**PreDicta™ B**

A management tool to reduce yield losses associated with disease. PreDicta™ B is a DNA based test which determines which soil borne pathogens pose significant risk before crops are sown. The tests relevant to beans measure soil inoculum levels of rhizoctonia bare patch and stem nematode.
Faba bean diseases and potential for cross infection from other pulses

<table>
<thead>
<tr>
<th>Disease</th>
<th>Faba beans</th>
<th>Lentils</th>
<th>Field peas</th>
<th>Vetch</th>
<th>Chickpeas</th>
<th>Lupins</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ascochyta blight</strong> <em>Ascochyta fabae</em></td>
<td>**</td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Cercospora leaf spot</strong> <em>Cercospora zonata</em></td>
<td>**</td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Chocolate spot</strong> <em>Botrytis cinerea</em></td>
<td>*</td>
<td>**</td>
<td>*</td>
<td>**</td>
<td>**</td>
<td>*</td>
</tr>
<tr>
<td><em>Botrytis fabae</em></td>
<td>**</td>
<td>*</td>
<td>**</td>
<td></td>
<td></td>
<td>**</td>
</tr>
<tr>
<td><strong>Rust</strong> <em>Uromyces viciae-fabae</em></td>
<td>**</td>
<td>*</td>
<td>**</td>
<td></td>
<td></td>
<td>**</td>
</tr>
<tr>
<td><strong>Sclerotinia stem rot</strong> <em>Sclerotinia spp.</em></td>
<td>**</td>
<td>**</td>
<td>*</td>
<td>**</td>
<td>**</td>
<td>**</td>
</tr>
<tr>
<td><strong>Stem nematode</strong> <em>Ditylenchus dipsaci</em></td>
<td>*</td>
<td>*</td>
<td>**</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td><strong>Virus: non-persistent</strong> <em>AMV, BBWYV, BYMV, CYVV and PSbMV</em></td>
<td>**</td>
<td>**</td>
<td>**</td>
<td>**</td>
<td>**</td>
<td>(*)</td>
</tr>
<tr>
<td><strong>Virus: persistent</strong> <em>BLRV, BWYV, SbDV and SCSV</em></td>
<td>**</td>
<td>**</td>
<td>**</td>
<td>**</td>
<td>**</td>
<td></td>
</tr>
<tr>
<td><strong>Root Rots</strong></td>
<td>*</td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Aphanomyces sp.</em></td>
<td>*</td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Fusarium sp.</em></td>
<td>*</td>
<td>*</td>
<td>**</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td><em>Phoma sp.</em></td>
<td>*</td>
<td>*</td>
<td>**</td>
<td></td>
<td>**</td>
<td>*</td>
</tr>
<tr>
<td><em>Pythium sp.</em></td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td><em>Rhizoctonia sp.</em></td>
<td>**</td>
<td>**</td>
<td>**</td>
<td>**</td>
<td>**</td>
<td>**</td>
</tr>
</tbody>
</table>

* This disease occurs on this crop but has not caused major damage.
** This disease has caused major damage on this crop.
Not a host.
(*) Not PSbMV.
## Fungicide guide

<table>
<thead>
<tr>
<th>Chemical</th>
<th>Seed treatment</th>
<th>Foliar fungicide</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Thiram + thiabendazole</td>
<td>Mancozeb</td>
</tr>
<tr>
<td>Products</td>
<td>P-Pickel T®, Fairgro®, Reaper®TT</td>
<td>Dithane Rainshied®, Penncozeb®, 750DF Manzate®DF®, Mancozeb®</td>
</tr>
<tr>
<td>(May 2009)</td>
<td>Representative products of many for most chemicals</td>
<td></td>
</tr>
</tbody>
</table>

### WHP

<table>
<thead>
<tr>
<th>Grazing</th>
<th>Harvest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not required</td>
<td>Not required</td>
</tr>
<tr>
<td>14 days</td>
<td>28 days</td>
</tr>
<tr>
<td>No grazing</td>
<td>None set</td>
</tr>
<tr>
<td>28 days</td>
<td>None set</td>
</tr>
<tr>
<td>1 day</td>
<td>3 days</td>
</tr>
<tr>
<td>14 days</td>
<td>3 days</td>
</tr>
</tbody>
</table>

### Disease

<table>
<thead>
<tr>
<th>Disease</th>
<th>Seed</th>
<th>Foliar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ascochyta blight</td>
<td>–</td>
<td>✓**</td>
</tr>
<tr>
<td>Chocolate spot</td>
<td>–</td>
<td>✓**</td>
</tr>
<tr>
<td>Cercospora</td>
<td>–</td>
<td>✓ –</td>
</tr>
<tr>
<td>Rust</td>
<td>–</td>
<td>✓**</td>
</tr>
<tr>
<td>Seedling root rots</td>
<td>✓*</td>
<td>–</td>
</tr>
</tbody>
</table>

- Disease controlled or suppressed
- P ✓ Permit for application
- Chemical registered for this disease in this crop
- # Chemical registered for use on this crop, but not for the disease
- – No control
- WHP Withholding period after application until grazing or harvest
- *** = high efficacy
- ** = medium efficacy
- * = low efficacy
- = no effect
- ® registered for this use on this crop

Go to PUBCRIS APVMA for full list of registered products: www.apvma.gov.au

# Check State registration for each product before use
## Fungicide spraying program

Early preventative fungicide applications have a season lasting effect through delaying build up of inoculum in the paddock.

<table>
<thead>
<tr>
<th>Critical period</th>
<th>Disease</th>
<th>Fungicide</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>First critical period</strong>&lt;br&gt;Early vegetative (6–8 weeks after emergence)</td>
<td>Ascochyta blight —</td>
<td>Mancozeb or chlorothalonil</td>
<td>Early fungicide application is critical to restrict early development and spread of disease.</td>
</tr>
<tr>
<td></td>
<td>Cercospora —</td>
<td>Carbendazim or tebuconazole</td>
<td>Use the lower rate on crops up to 20 cm in height. Use the higher rate for dense crops or if disease pressure is severe.</td>
</tr>
<tr>
<td></td>
<td>Ascochyta blight plus Cercospora</td>
<td>Carbendazim or tebuconazole + mancozeb, or chlorothalonil by itself</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cercospora plus Ascochyta blight</td>
<td>Carbendazim or tebuconazole + either mancozeb or chlorothalonil</td>
<td>If ascochyta is detected, and/or chocolate spot appear in the upper third of the crop canopy, and rain or high humidity are likely, then apply fungicide if crop has sufficient yield potential.</td>
</tr>
<tr>
<td></td>
<td>Rust plus Chocolate spot</td>
<td>Mancozeb or chlorothalonil</td>
<td>If rust is an early target in Northern Australia</td>
</tr>
<tr>
<td><strong>Second critical period</strong>&lt;br&gt;During flowering (13–16 weeks after emergence)</td>
<td>Ascochyta blight plus Chocolate spot</td>
<td>Mancozeb or chlorothalonil</td>
<td>Mid-flowering is recommended.</td>
</tr>
<tr>
<td></td>
<td>Chocolate spot plus Ascochyta blight</td>
<td>Either carbendazim or procymidone + either mancozeb or chlorothalonil</td>
<td>If ascochyta is detected, and/or chocolate spot appear in the upper third of the crop canopy, and rain or high humidity are likely, then apply fungicide if crop has sufficient yield potential.</td>
</tr>
<tr>
<td></td>
<td>Chocolate spot plus Cercospora</td>
<td>Carbendazim or chlorothalonil</td>
<td></td>
</tr>
<tr>
<td><strong>Third critical period</strong>&lt;br&gt;End of flowering when pods are filling (15–20 weeks after emergence)</td>
<td>Ascochyta blight and/or Rust plus Chocolate spot</td>
<td>Mancozeb or chlorothalonil</td>
<td>If ascochyta is detected, rain is likely or new spots of chocolate spot appear on unprotected leaves on the upper third of the plant, apply fungicide if the crop has sufficient yield potential.</td>
</tr>
<tr>
<td></td>
<td>Chocolate spot plus Ascochyta blight and/or Rust</td>
<td>Either carbendazim or procymidone + either mancozeb or chlorothalonil</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Chocolate spot —</td>
<td>Carbendazim or procymidone</td>
<td>Observe all withholding periods.</td>
</tr>
</tbody>
</table>
**Aphanomyces root rot** (*Aphanomyces euteiches*)

This disease has only recently been reported on faba beans in Australia. Its prevalence and impact on faba bean is yet to be determined. *A. euteiches* has also been reported on peas and subterranean clover in Australia.

**Description**
Diseased plants are likely to appear in clusters within waterlogged areas. Severely affected plants become stunted and die, with complete rotting of primary and secondary roots. Diseased plants pulled from the soil often retain only the centre stele of the top part of the root. Plants with less severe root rot may be found outside the clusters and show root discoloration and an absence of nodulation. Above ground symptoms of less affected plants (yellowing, premature defoliation and earlier maturity) can be easily mistaken with symptoms caused by nutrient deficiency, drought stress or virus infection.

**Management**
High levels of resistance to *A. euteiches* are not yet incorporated into commercial faba bean cultivars. No specific *A. euteiches* fungicide seed treatments are available. Waterlogged soils attract root rots (*A. euteiches* as well as others) and good management practices to reduce waterlogging will reduce risks. *A. euteiches* affects a range of pulse hosts (field pea, pasture legumes), so the disease can be found in paddocks without a history of faba bean cultivation.


*Image:* Joop van Leur – NSW DII
Ascochyta blight (*Ascochyta fabae*)

**Description**

Dark leaf spots which show through both sides, becoming grey with age.

Leaf spots are circular, becoming elongated; pale centres may fall out leaving holes in leaf; tiny black fruiting bodies develop within lesions.

Stems develop elongated, dark, sunken lesions; stems may split and break causing plants to lodge.

Pods develop black, sunken lesions, which can penetrate the pod and infect the developing seed. Badly infected seeds have brown or black stains.

First appears on leaves of seedlings when wet cold conditions occur, usually well before flowering.

Progresses to infect upper leaves, flowers, stems and pods.

Infection on mature pods leads to seed staining, especially when late rains occur pre-harvest. Can develop on pods of windrowed crops.

Widespread in southern Australia.

**Management**

Grow varieties with resistance; sow disease-free seed; use crop rotation; sow away from bean residues (including self-sown plants). Apply fungicide 6–8 weeks after sowing, during seedling stages. Spray before an average infection of one lesion per plant develops and rainfall is likely during the next week. A late fungicide application after flowering and no new growth is occurring assists in preventing seed staining.

*Images: R Kimber, SARDI*
**Cercospora leaf spot (Cercospora zonata)**

**Description**
Black/brown-red circular lesions with a distinct margin on leaves; lesions expand irregularly. Concentric ring pattern may develop within lesions. Can be confused with Ascochyta blight lesions early in the season although Cercospora lesions can be darker at first, then progress toward brown-red and more irregular in shape. Lesions do not produce dark fruiting bodies like Ascochyta.

First appears on lower leaves of seedlings in wet cold conditions; often arises earlier than Ascochyta.

Infection can progress to mid–upper leaves, stems and pods later in the season and can be confused with chocolate spot. Severe infection results in significant defoliation.

A widespread soil borne disease, particularly in regions with longterm, close rotation of faba beans.

**Management**
It is essential to control infected crops early with fungicide at 6–8 weeks after sowing.

Fungicide applied during flowering and pod fill to control chocolate spot may also control Cercospora.

Current bean varieties have no useful varietal resistance to Cercospora.

Images: R Kimber, SARDI

Lesions first appear on the lowest leaves of seedlings early in the growing season.

Lesions start circular, then become irregular.
Chocolate spot (*Botrytis cinerea* and *B. fabae*)

**Description**

Major disease in all bean growing areas. Infects plants at any stage but worse after flowering; defoliates plants and reduces pod set.

Favoured by temperatures 15 to 25°C and high humidity (70%+) for 4 to 5 days. Very rapid build up (aggressive stage) during warm, humid conditions late in the season. Worse in early sown and dense crops and heavy wet soils. Fluffy, grey fungal growth produces masses of spores on fallen leaves and petals under wet conditions.

Spots initially pinhead sized circular reddish-brown on leaves and flowers; initially spots on one side of leaf only, most obvious as ‘chocolate spots’ early in the season. Spots expand rapidly under suitable conditions, blackening and killing large areas of leaf; infection can spread into stems. *Cercospora* can produce similar small reddish-brown spots on leaves.

Flowers turn brown and are killed, reducing pod set. Pods develop reddish-brown pinhead sized spots.

Pods may split allowing infection of seed, which may be covered in small reddish-brown spots. Severe infection can result in complete crop failure.
**Management**
Grow varieties with resistance; delay sowing; use crop rotation; sow away from bean residues (including self-sown plants). Check the crop every seven days when temperatures below 15°C. Check every three days when 15–20°C and humidity over 70%.

**Less than 450 mm/yr** – apply a protective fungicide:

**Early sown crops:** before five spots per leaflet develop on the lower half of plant if high humidity is likely for at least one week. Repeat in advance of rainfall events when seasonal conditions favour disease spread (i.e. humidity in the crop high for at least a week).

**Late sown crops:** when flowering commenced and humidity in the crop is likely to be high for at least a week, especially if signs of infection are present.

**More than 450 mm/yr** – apply a protective fungicide:
– Before flowering if more than five spots per leaflet on the lower half of the plant.
– At start of flowering if high humidity is likely for at least one week, even if no disease is present.

Repeat (10–21 days in severe cases) before rain, as determined by unprotected growth, rain since last application and expected rain. Last spray when flowering ceased and no new growth expected.

*Images: M Ramsey, formerly SARDI; R Kimber, SARDI*
Downy mildew (*Peronospora vicia*)

Not present in Australia.

**Description**
Systemically infected plants are stunted and pale green; masses of grey–fawn fungal growth on undersurfaces of leaves and on stems.

Leaf lesions brown on top with grey–fawn fungal growth underneath.

Symptoms quite characteristic, but could be confused with non specific tip burning.

Occurs in the Nile Valley, Europe and parts of the USA.
Root rots *(Fusarium, Phoma, Rhizoctonia and Pythium sp.)*

**Description**

Plants are stunted and often die in patches.
Leaves yellow and wilt before dying.
Crown and stem bases are brown to black.
Roots are blackened and root system severely reduced.
Lateral roots are short with tips rotted and often pointed if *Rhizoctonia*.

*Rhizoctonia* is favoured by weed and plant growth before sowing, sandy infertile soils and is more common if no-tilled.

**Management**

Control plant growth for at least several weeks prior to sowing.
Ensure adequate nutrition.
Shattering the soil below seed level at seeding will reduce *Rhizoctonia*.
Avoid situations where wet, cold weather with poor soil structure and free surface water. Also close rotations of faba beans or other pulses, especially field peas and chickpeas.

Red *Rhizoctonia* lesions on the hypocotyl.

*Rhizoctonia* – lower stem (collar) is rotted with short lateral roots.

Fusarium root rot.

Phoma on roots and crown.

*Images*: T Bretag, formerly VDPI; M Ramsey, formerly SARDI
Rust *(Uromyces viciae-fabae)*

**Description**
Severe infection causes premature defoliation, resulting in reduced seed size.

Initial infection as creamy coloured spore masses on leaves; replaced by orange–brown pustules surrounded by a light yellow halo; severely infected leaves wither and drop off.

Rust pustules on stems are similar but often larger than on leaves; pustules become darker as plants mature. Isolated rust pustules may develop on the pods.

Favoured by warm (20–30°C) conditions and in southern regions is normally only a problem at the end of the season. In warmer northern regions infection occurs in autumn where early control is essential.

Can develop very quickly under favourable conditions. At 20–25°C the rust cycles every 10 days.

**Management**
Sow away from bean trash and self-sown plants remaining after sowing.

Where broad-spectrum fungicides are used as treatments for the other diseases, separate rust control is unlikely to be needed unless the product used does not control rust (e.g. *carbendazim*, *procymidone*).

*Images: R Kimber, SARDI*

Orange–brown spots on leaves surrounded by a light yellow halo.

Pustules on stems are often larger, becoming darker as plant matures.
**Sclerotinia stem rot** (*Sclerotinia minor, S. sclerotiorum and S. trifoliorum*)

**Description**

Affects isolated plants at any stage of growth. Plants wilt and collapse.

Infects stems, leaves or pods; young plants develop a slimy-wet rot at ground level.

Plants have a blackened base covered with fluffy, white fungal growth and are easily pulled from the soil.

Sclerotones (2 to 5 mm in diameter) form on the surface and in the centre of stems. Sclerotones are white at first, then turn black and hard.

Occurs where a high number of pulse and oilseeds in the rotation; high seeding rates; cool wet conditions.

**Management**

Once established in a crop is difficult to control. Lower seeding rates, wider row spacing and good weed control give a more open crop less prone to disease.

Rotation with cereals will decrease soil inoculum level.
Stem nematode (*Ditylenchus dipsaci*)

**Description**
Patches of malformed and stunted plants.
Leaves curled with water-soaked spots.
Stems sometimes die back, turning reddish brown from the base and stopping at a leaf.
Herbicide damage can produce similar symptoms.
Only occurs in parts of South Australia.
Is worse in wet conditions.

**Management**
Sow nematode free seed. Use PreDicta™ B to assess soil status before sowing.
Do not introduce through infected straw/hay or infected seed.
Avoid rotations of susceptible crops and weeds e.g. oats, wild oats, peas, vetch, and some broad leaf weeds (e.g. bedstraw) that increase nematode populations.

Malformed and stunted plant with curled leaves.

*Image: A Dube, formerly SARDI*
Controlling viruses

Faba bean crops can be affected by a number of virus diseases. Some are seed borne, but most rely on living plant tissue (green bridge) to survive between seasons.

AMV, BBWV, BYMV, CYVV and PSbMV are “non-persistent” in aphids and the aphid vectors soon lose their infectivity after feeding on healthy plants. Generally these viruses therefore only spread over short distances.

BLRV, BWYV, SbDV and SCSV (yellowing or luteoviruses) are “persistent” in aphids, which means that the aphids remain infected for life. These viruses can spread over long distances, but the relatively long feeding time needed for the aphid to transmit the virus makes them more responsive to control by insecticides.

Virus symptoms can include yellowing, leaf mottles or mosaics, stunting and tip distortion. Symptoms can easily be mistaken for herbicide damage, nutrient deficiencies, salinity effects or other abiotic factors. It is difficult to diagnose a virus just on field symptoms and growers are advised to seek expert advice. Crop patches or rings which increase over time often indicate the presence of a virus. Presence of aphids may indicate symptoms are caused by virus.

1. Seed-borne viruses can be controlled by sowing virus free seed (<0.1% seed infection in high risk areas, <0.5% seed infection in low risk areas). Infection can come from infected neighbouring crops.

2. Minimise aphid landing sites. Avoid bare soil – aphids land in crops where there is a clearly defined contrast in colour between bare soil and green foliage. Ensure good crop establishment, retain standing cereal stubble and produce a dense canopy.

3. Minimise herbicide stress, as stressed plants are more attractive to aphids.

4. Control in-crop weeds (potential sources of virus and/or vectors) early.
Mosaic viruses: *Bean yellow mosaic virus* (BYMV), *Clover yellow vein virus* (CYVV), *Pea seed-borne mosaic virus* (PSbMV), *Broad bean wilt virus* (BBWV)

**Description**
Mosaic of dark green patches over pale green leaves, leaves mildly to severely distorted or with uneven surface. Little or no plant stunting. Upper leaves cupped and erect, occasionally dead and blackened.

BYMV is widespread and common; other viruses are localised or less common.

Transmitted from other infected legumes by aphids.

**Management**
Use disease-free seed.

Prevent establishment of aphids in the crop.

Avoid planting near infected crops and pasture e.g. lucerne, medic and clovers.

Sow dense crops or avoid bare ground through having stubble cover.

*Images: M Ramsey, formerly SARDI; W Hawthorne, Pulse Australia; M Schwinghamer, NSW DPI*
Yellowing viruses: *Bean leafroll virus* (BLRV), *Subterranean clover redleaf virus* (SCRLV), *Beet western yellows virus* (BWYV), *Subterranean clover stunt virus* (SCSV)

**Description**
Early infected whole plants are stunted and often die prematurely.

Late infection only affects the top of branches (‘top yellows’).

Leaves turn yellow, and become stiff later. Sometimes leaf edges are rolled upwards and leaflets come together giving leaves an upright appearance.

Causes major yield losses in parts of northern and central NSW.

BLRV is the most common and damaging virus.

Transmitted by aphids from neighbouring infected pulses and pasture legumes, particularly lucerne.

**Management**
Prevent establishment of aphids in the crop.

Avoid planting near infected crops and pasture e.g. lucerne, medic and clovers. Sow dense crops or avoid bare ground through having stubble cover.

*Images: M Ramsey, formerly SARDI; M Schwinghamer, NSWDPI*
Faba beans do not compete with weeds well despite early plant vigour, as initial relatively thin plant populations reduce their competition with early weeds. Tall bulky crops compete better against later emerging weeds.

It is essential to plan your weed control strategy before sowing. Delaying sowing to achieve several weed kills before sowing is not an option in many areas as faba beans need to be sown early. Application of pre-emergent herbicides is useful, and for broadleaf weeds the only option. Most grass weeds can be controlled either pre or post-emergence. Take care to apply the herbicide at the right stage of bean and weed growth.

Beans provide a valuable opportunity to use alternative weed control practices to those used in cereal and oilseed phases. The opportunity to use grass herbicides, alternative herbicides and herbicide groups, as well as crop topping, assists in reducing the soil seed bank and hard to control weeds. Crop topping can reduce bean yields, but reduces the seed set of weeds, allowing minimal or no movement of the weed population towards resistance.

Weeds can greatly affect returns from a bean crop and increase the carry over of weed seeds to following crops.

Image: M Seymour, DAFWA
Effective weed control

Ensure a low seed bank of weeds. Controlling smaller weeds will usually result in more effective, more reliable and cheaper control with lower rates of herbicide.

No-till farming results in fewer incorporated weed seeds and earlier, less staggered germinations. Herbicides need to be applied while canopies still allow adequate spray coverage of weeds.

Weeds such as bedstraw and bifora once limited the planting of faba beans, but a limited number of herbicides now enable control of these weeds. Lack of early crop competition can also result in ryegrass infested crops, but crop topping helps make faba beans a more robust part of a rotation. The control of vetch and medic in faba bean crops still largely relies on pre-season seed bank management.

- Control weeds as early as possible.
- Control when weeds and the crop are at the correct growth stage.

• Do not spray when weeds or the crop are under stress.
• Check the ‘rainfast’ period prior to rain.
• Do not spray in windy conditions over 15km/hr.
• Use the right nozzle output and droplet size to ensure adequate coverage.
• Ensure the sprayrig is properly cleansed of damaging residual chemicals.
• Check the withholding period for grazing and harvest.

Image: M Seymour, DAFWA

The seed set of wild radish and ryegrass will affect future paddock management and profits.
Avoiding herbicide damage

Most post-sowing pre-emergent (PSPE) herbicides can cause damage under adverse conditions. Incorporating herbicide by seeding (IBS) can be safer. Post-emergent applications of some broadleaf herbicides under pesticide permits can cause crop damage, reduce height, and delay flowering and pod formation in some circumstances.

Damage with PSPE herbicides can be attributed in most cases to product solubility and sowing too shallow, accumulation of herbicide into furrows from press wheels or an uneven soil surface. Herbicide applied to dry soil followed by heavy rainfall can also wash into the crop root zone.

To reduce the risks of herbicide damage when using soil active products PSPE on beans:

- Sow at 5 cm or deeper.
- Apply herbicide to a level soil surface (e.g. after prickle chaining, rolling).
- Ensure rolling after press wheels levels the furrow enough.

- Avoid applying herbicide post-sowing to dry soils in front of heavy rainfall.
- Choose the right rate for your soil type (lower rates for lighter soils).
- Apply herbicide incorporated by seeding (IBS) or a split application.
Herbicide injury

Causes of herbicide injury include:

- Incorrect rate or timing of application.
- Susceptible cultivar.
- Ridged soil which allows herbicide wash.
- Shallow seeding depth.
- Adverse weather or soil conditions.
- Herbicide drift.
- Residual soil herbicide or spray tank contamination.

Effects of herbicide injury vary. Herbicide damage may be very obvious, such as with scorched leaves, or more subtle, such as with poor establishment or delayed maturity. Symptoms can vary from slight stunting or leaf discolouration to crop death, depending on the type of herbicide, dose received, crop susceptibility and seasonal conditions.

Herbicide crop injury symptoms can easily be confused with symptoms produced by other causes, such as from frost, disease, nutrient deficiencies or toxicities. Correctly diagnosing the cause of a specific set of symptoms can be difficult.

Symptoms of damage to the crop from herbicides do not always mean there will be a loss in grain yield. Herbicide damage often predisposes plants to leaf disease which may be more damaging.

Seek technical advice on herbicides, rates and growth stages for application from agronomic consultants, chemical resellers, spray charts and crop production manuals produced by State Departments of Primary Industries.

Image: A Mayfield, Allan Mayfield Consulting
Herbicide damage effects and symptoms in faba beans

**Group B**  Inhibitors of the enzyme ALS

<table>
<thead>
<tr>
<th>Sulfonylureas (SU’s)</th>
<th>Triazolopyridines</th>
<th>Imidazolinones (IMI’s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical name</td>
<td>Trade name*</td>
<td>Chemical name</td>
</tr>
<tr>
<td>metsulfuron</td>
<td>Ally®</td>
<td>flumetsulam</td>
</tr>
<tr>
<td>chlorsulfuron</td>
<td>Glean®</td>
<td>metosulam</td>
</tr>
<tr>
<td>iodosulfuron</td>
<td>Hussar®</td>
<td>florasulam</td>
</tr>
<tr>
<td>triasulfuron</td>
<td>Logran®</td>
<td></td>
</tr>
<tr>
<td>sulfosulfuron</td>
<td>Monza®</td>
<td></td>
</tr>
<tr>
<td>mesosulfuron + mefenpyr</td>
<td>Atlantis®</td>
<td></td>
</tr>
</tbody>
</table>

*Representative products of many for most chemicals.

**Description**

Seedlings may emerge and grow for several weeks before plants become stunted with shortened internodes. New foliage is yellow to red to purplish, progressing throughout the plant. Leaf curl may be apparent. Growth of lateral roots may be reduced.

**Management**

Follow label plant-back periods where high pH soils (> pH$_{CaCl_2}$ 7.5). Avoid cold, wet conditions, conditions that stress and prevent the plant recovering, zinc deficiency and compacted soil (e.g. wheel tracks).

Grass herbicides can strip residues from the spray boom and tank.

Sulfonylurea urea damage to faba bean plants. Note the leaf curl and stunting of the plants.

*Image: T Bretag, formerly VDPI
**Description**
Symptoms develop rapidly but require light. Rapid yellowing and necrosis beginning at the edge of the leaves leads to their desiccation and burnt appearance. Interveinal chlorosis or veinal chlorosis can occur.

**Management**
Follow plant-back periods as indicated on the label where soils are alkaline and calcareous, leachable with low organic matter, or of lighter texture. Duplex soils with shallow sand over heavy clay also present a risk of damage.

Avoid ridged soil and shallow sowing where herbicide can leach into seed furrows.

---

**Group C  Inhibitors of photosynthesis**

<table>
<thead>
<tr>
<th>Triazine</th>
<th>Trade name*</th>
<th>Triazinone</th>
<th>Trade name*</th>
<th>Urea</th>
<th>Trade name*</th>
</tr>
</thead>
<tbody>
<tr>
<td>atrazine</td>
<td>Gesaprim®</td>
<td>metribuzin</td>
<td>Lexone®, Sencor®</td>
<td>diuron</td>
<td>Karmex®, Krovar®</td>
</tr>
<tr>
<td>simazine</td>
<td>Gesatop®</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>terbutryn</td>
<td>Igran®</td>
<td>bromoxynil</td>
<td>Buctril®, Jaguar®</td>
<td>pyridate</td>
<td>Tough®</td>
</tr>
</tbody>
</table>

*Representative products of many for most chemicals.

(Left) Simazine damage more severe on sandy soils with low organic matter content.

(Right) Black leaf margins from simazine damage.

Images: A Mayfield, Allan Mayfield Consulting
**Group D** Inhibitors of cell division

<table>
<thead>
<tr>
<th>Dinitro-anilines (DNAs)</th>
<th>Benzamides</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Chemical name</strong></td>
<td><strong>Trade name</strong>*</td>
</tr>
<tr>
<td>pendimethalin</td>
<td>Stomp®</td>
</tr>
<tr>
<td>trifluralin</td>
<td>Trifluralin®</td>
</tr>
<tr>
<td>trifluralin + oryzalin</td>
<td>Yield®</td>
</tr>
</tbody>
</table>

*Representative products of many for most chemicals.

**Description**

Visual symptoms appear as the crop emerges with intermittent emergence along drill rows as a result of shortening and thickening of the hypocotyl.

Seeds germinate, but shoots are unable to emerge. Emerging leaves in affected plants may be twisted and distorted.

Roots can be shortened and thickened.

**Management**

Avoid sowing seed into the layer of herbicide treated soil. This results from the seeder set-up resulting in variable depth of sowing, or sowing too fast throwing herbicide treated soil onto adjacent furrows.

Symptoms are often worse where wet cold conditions, and slow germination and emergence.

(Above) Poor emergence on left caused by trifluralin damage.

(Right) Trifluralin has shortened and thickened roots of seedling on the left.

Images: W Hawthorne, Pulse Australia; C Preston, University of Adelaide
**Group F**  Inhibitors of carotenoid biosynthesis

<table>
<thead>
<tr>
<th>Nicotianalides</th>
<th>Picolinamide</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical name</td>
<td>Trade name*</td>
</tr>
<tr>
<td>diflufenican</td>
<td>Brodal®</td>
</tr>
</tbody>
</table>

*Representative products of many for most chemicals.

**Description**
White/yellow spots/bands may develop within three to four days after application (two days in bright sunny weather).

Plants turn light green and whole leaves turn yellow to cream colour.

Effects disappear as new growth develops with no long term effects.

**Management**
Effects are worse when applied to crops suffering stress such as frost, cold wet conditions, or high temperatures soon after spraying.

Sprayed leaves white to pale yellow with yellow blotches.

*Image: A Mayfield, Allan Mayfield Consulting*
**Group G  Inhibitors of protoporphyrinogen**

<table>
<thead>
<tr>
<th>Diphenylethers</th>
<th>Triazolinone</th>
<th>Pyrimidindione</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical name</td>
<td>Trade name*</td>
<td>Chemical name</td>
</tr>
<tr>
<td>oxyfluorfen</td>
<td>Goal®</td>
<td>carfentrazone</td>
</tr>
<tr>
<td></td>
<td>Spark®</td>
<td></td>
</tr>
<tr>
<td>N-diphenylphthalamides</td>
<td>Striker®</td>
<td></td>
</tr>
<tr>
<td>flumioxazin</td>
<td>Pledge®</td>
<td></td>
</tr>
</tbody>
</table>

*Representative products of many for most chemicals.

**Description**
Numerous white spots on the leaves from the droplets of herbicide contact within one or two days of application.

May lead to desiccation and death in beans although grasses and cereals generally recover.

**Management**
Ensure that herbicide drift does not occur onto faba bean crops, especially where fine droplets are targeted for the use of products as indicated by the label.
Group I Disruptors of plant cell growth

<table>
<thead>
<tr>
<th>Phenoxycarbolic acids</th>
<th>Benzoic acids</th>
<th>Pyridines</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical name</td>
<td>Trade name*</td>
<td>Chemical name</td>
</tr>
<tr>
<td>2,4D amine</td>
<td>Many</td>
<td>dicamba</td>
</tr>
<tr>
<td>2,4D ester</td>
<td>Many</td>
<td></td>
</tr>
<tr>
<td>MCPA amine</td>
<td>Many</td>
<td></td>
</tr>
<tr>
<td>MCPA ester</td>
<td>Many</td>
<td></td>
</tr>
<tr>
<td>MCPB</td>
<td>MCPB®</td>
<td></td>
</tr>
<tr>
<td>2,4DB</td>
<td>Trifolamine®</td>
<td></td>
</tr>
</tbody>
</table>

*Representative products of many for most chemicals.

Description

Visual symptoms appear within 3 to 4 days of application. Plants start to twist and appear misshapen with downward bending and twisting of stems and petioles.

Stems swell – especially at nodes, elongation, leaf cupping and curling.

This is followed by yellowing at the growing point, reduced growth, wilting and necrosis.

Leaves may be mottled. Leaf spotting without the ‘hormonal’ distortion can occur with MCPB.

Death occurs slowly over 3–5 weeks.

Clopyralid residues occur where a dry season following application.

Management

Do not seed if there might be residues from pre-sowing application.

Ensure that herbicide drift does not occur onto faba bean crops.
Group J  Inhibitors of fat synthesis

<table>
<thead>
<tr>
<th>Thiocarbamates</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical name</td>
<td>Trade name*</td>
</tr>
<tr>
<td>tri-allate</td>
<td>Avadex®</td>
</tr>
</tbody>
</table>

*Representative products of many for most chemicals.

**Description**
Visual symptoms appear underground or as the crop emerges with reduced or poor seedling emergence.

Shoots, if emerged, are often swollen and bright green.

Roots are often pruned, leaving stubby root knobs.

**Management**
Ensure seed is not sown into the band of herbicide in the soil. Effects are worse when wet cold conditions slow germination and emergence.
**Group K** Inhibitors of cell division and very long chain fatty acids

<table>
<thead>
<tr>
<th>Chloroacetamides</th>
<th></th>
<th>Trade name*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical name</td>
<td>Trade name*</td>
<td></td>
</tr>
<tr>
<td>metolachlor</td>
<td>Dual®</td>
<td></td>
</tr>
</tbody>
</table>

*Representative products of many for most chemicals.

**Description**
Visual symptoms appear as the crop emerges with reduced or poor seedling emergence. In most cases weeds do not appear. Seedlings are malformed and twisted, with transitory crop yellowing.

**Management**
Ensure seed is not sown into the band of herbicide in the soil.

Effects are more severe in light textured soils with low organic matter, in waterlogged conditions, where crops are stressed from lack of moisture or lack of nutrients, and when frost occurs within 10 days of application.

Image: C Preston, University of Adelaide
**Group L  Inhibitors of photosynthesis (photosystem I)**

<table>
<thead>
<tr>
<th>Bipyridyls</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical name</td>
<td>Trade name*</td>
</tr>
<tr>
<td>paraquat</td>
<td>Gramoxone®</td>
</tr>
<tr>
<td>diquat</td>
<td>Reglone®</td>
</tr>
<tr>
<td>diquat + paraquat</td>
<td>Spray.Seed®</td>
</tr>
</tbody>
</table>

*Representative products of many for most chemicals.

**Description**
Visual symptoms appear within hours of application with spots of dead tissue on otherwise healthy leaves. There may also be wilting and inter-veinal yellowing followed by browning and blackening of the leaf edges.

Plants shrivel up within four days of application if damage is severe.

Signs are often worse on one side of the plant or stem.

Effects disappear as new growth develops.

**Management**
Ensure that herbicide drift does not occur onto faba bean crops.

*Images: W Hawthorne, Pulse Australia; C Preston, University of Adelaide*
**Group M** Inhibitors of amino acid synthesis

<table>
<thead>
<tr>
<th>Glycines</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Chemical name</strong></td>
</tr>
<tr>
<td>glyphosate</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

*Representative products of many for most chemicals.

**Description**
Symptoms are most obvious at growing points within five to seven days of application.

Plants are stunted (growth stopped until recovery or death) with leaves turning yellow to red, followed by browning.

There may be some twisting of plants.

Plants look flaccid and tend to lie on the soil surface.

**Management**
Ensure that herbicide drift does not occur onto faba bean crops.

*Images: C Preston, University of Adelaide; W Hawthorne, Pulse Australia*
**Chemical leaf spotting**

**Description**
Grey or brown spots on leaves, which do not necessarily show through both sides.

Herbicide (e.g. Group A) applied at high temperature with oils or surfactants added.

Leaf burning from trace element foliar applications.

From frost or high temperatures soon after spraying.

**Management**
Be alert to label restrictions for temperature, frost, water rates, droplet size, additives and adjuvants.

*(Above) Spots are numerous but small and irregular in shape and often differ on both sides of the leaf.*

*(Right) Herbicide spots on the leaf.*

Images: R Kimber, SARDI; W Hawthorne, Pulse Australia
Avoiding and managing herbicide resistance

Key points on resistance:
1. Weed numbers – the higher the numbers the greater the risk of resistant weeds being present.
2. Each herbicide application will increase the proportion of resistant individuals in the population.
3. Resistance is generally not reversible (particularly for Group A and B herbicides).
4. The proportion of resistance in subsequent populations is not increased after the use of a herbicide if seed set is prevented.
5. Resistance occurs quickest where there is repeated use of only a limited number of weed control methods.

Management tactics

<table>
<thead>
<tr>
<th>Tactic</th>
<th>Management</th>
<th>Practical issues</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deplete weed seed bank in the soil</td>
<td>Burn residues</td>
<td>Increase erosion risk on some soils</td>
</tr>
<tr>
<td></td>
<td>Invert seedbank by ploughing</td>
<td>Only practical in deep soils</td>
</tr>
<tr>
<td></td>
<td>Autumn tickle</td>
<td>Useful to increase weed germination</td>
</tr>
<tr>
<td></td>
<td>Delay sowing</td>
<td>Only practical in years with an early break</td>
</tr>
<tr>
<td></td>
<td>No till seeding</td>
<td>Keeps seed on surface from germinating</td>
</tr>
<tr>
<td>Control seedling weeds in the target area</td>
<td>Fallow and cultivate pre-sowing</td>
<td>Can increase germination of dormant weed seeds</td>
</tr>
</tbody>
</table>

**Herbicides**

- Knockdown herbicides: Glyphosate or paraquat plus spike for difficult to control weeds
- Double knockdown: Glyphosate followed by paraquat three to four days later
- Pre-emergent herbicides: Trifluralin (Group D) + Dual® Gold (Group K) or Avadex® (Group E) mix
<table>
<thead>
<tr>
<th>Tactic</th>
<th>Management</th>
<th>Practical issues</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selective post-emergent herbicides</td>
<td>Group A herbicides applied when weeds small and actively growing</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Clearfield™ system</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Atrazine and simazine application to triazine tolerant varieties</td>
<td></td>
</tr>
<tr>
<td>Non-selective post-emergent herbicides</td>
<td>Glyphosate application to Roundup Ready® varieties</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Glufosinate application to InVigour® varieties</td>
<td></td>
</tr>
<tr>
<td>Crop competition</td>
<td>Sow early using narrow row spacing</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ensure correct sowing depth and good seed soil contact for rapid and even emergence</td>
<td></td>
</tr>
<tr>
<td>Stop weed seed set</td>
<td><strong>In crop weed management</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Cut for hay</strong></td>
<td>This may be the best longer term option where there are high numbers of resistant weeds</td>
</tr>
<tr>
<td></td>
<td><strong>Windrowing</strong></td>
<td>Will reduce seed set</td>
</tr>
<tr>
<td></td>
<td><strong>Crop topping</strong></td>
<td>Apply Roundup Power Max® or paraquat to kill surviving plants/stop seed set</td>
</tr>
<tr>
<td>Prevent viable weed seeds being added to seed bank</td>
<td><strong>Weed seed collection at harvest</strong></td>
<td>May be impractical; slowing harvest, demand on header power, disposal of weed seeds</td>
</tr>
<tr>
<td></td>
<td><strong>Weed seed destruction at harvest</strong></td>
<td>Not yet available; greater power requirement; degree of effectiveness</td>
</tr>
<tr>
<td></td>
<td><strong>Narrow header rows</strong></td>
<td>Enables header rows to be burnt</td>
</tr>
<tr>
<td>Prevent introduction of viable weed seed</td>
<td>Sow weed-free seed</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Clean farm machinery and vehicles</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Prevent introduction in hay and grain</td>
<td></td>
</tr>
</tbody>
</table>
Faba beans should be self sufficient for nitrogen if well nodulated. Rates of 5–10 kg/ha of ‘starter’ N to aid establishment may be useful on lighter and slightly acid soils.

Phosphorus removal is about 4 kg P per tonne of grain. Apply phosphorus to replace grain removal and soil tie-up to maintain available P levels. More is required on soils such as calcareous soils with a higher buffering index. Soil tests are best able to indicate P availability.

Use tissue testing to monitor the availability of trace elements. Zinc is required for faba beans on alkaline soils. Manganese is sometimes required for faba beans on highly alkaline soils or under fluffy soil conditions. Foliar applications of iron may be needed for faba beans grown on highly alkaline and wet soils. Faba beans may respond to molybdenum in soils that are deficient.
As for other crops, faba beans need an adequate supply of both the major and minor nutrients for growth and to maximise yield. When grain is harvested from the paddock, nutrients are removed in the grain in the following amounts.

**Guide to nutrient removal in one tonne of faba bean grain**

<table>
<thead>
<tr>
<th>Major nutrients (kg)</th>
<th>Minor nutrients (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen N</td>
<td>Copper Cu</td>
</tr>
<tr>
<td>Phosphorus P</td>
<td>Zinc Zn</td>
</tr>
<tr>
<td>Potassium K</td>
<td>Manganese Mn</td>
</tr>
<tr>
<td>Sulphur S</td>
<td></td>
</tr>
<tr>
<td>Calcium Ca</td>
<td></td>
</tr>
<tr>
<td>Magnesium Mg</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Major nutrients (kg)</th>
<th>Minor nutrients (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen N</td>
<td>Copper Cu</td>
</tr>
<tr>
<td>Phosphorus P</td>
<td>Zinc Zn</td>
</tr>
<tr>
<td>Potassium K</td>
<td>Manganese Mn</td>
</tr>
<tr>
<td>Sulphur S</td>
<td></td>
</tr>
<tr>
<td>Calcium Ca</td>
<td></td>
</tr>
<tr>
<td>Magnesium Mg</td>
<td></td>
</tr>
</tbody>
</table>

The main deficiencies encountered in faba beans are:

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen</td>
<td>When nodulation is poor or ineffective (e.g. in acid soils)</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>On high production or calcareous ground with inadequate history of phosphorus input</td>
</tr>
<tr>
<td>Zinc</td>
<td>On many alkaline cropping soils</td>
</tr>
<tr>
<td>Manganese</td>
<td>On soils with high lime content</td>
</tr>
</tbody>
</table>

**Toxicity**

Faba beans are affected by high salinity and boron levels encountered in sub-soils in many areas in the southern cropping zone in Australia. They are also very sensitive to aluminium and manganese toxicity which often occur on acidic soils generally unsuitable for faba beans.

Leaf edge death from boron toxicity.  
*Image: N Wilhelm, SARDI*
### Key to deficiencies in faba beans

<table>
<thead>
<tr>
<th>SYMPTOM</th>
<th>Old to middle leaves</th>
<th>Middle to new leaves</th>
<th>New leaves to terminal shoots</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N  P  S  K  Mg  Zn</td>
<td>N  Mg  Mn  Zn  B</td>
<td>Mn  Fe  Zn  Cu  Ca  B</td>
</tr>
<tr>
<td>DEFICIENCY</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chlorosis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Complete</td>
<td>x x x</td>
<td></td>
<td>x x x</td>
</tr>
<tr>
<td>Mottled</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intervenial</td>
<td></td>
<td>x</td>
<td>x x</td>
</tr>
<tr>
<td>On margins</td>
<td>x x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Necrosis</td>
<td></td>
<td>x x</td>
<td></td>
</tr>
<tr>
<td>Complete</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distinct areas (including spotting)</td>
<td>x x x x</td>
<td></td>
<td>x x x x</td>
</tr>
<tr>
<td>Margins</td>
<td></td>
<td>x</td>
<td>x x</td>
</tr>
<tr>
<td>Tips</td>
<td>x x</td>
<td></td>
<td>x x x x x</td>
</tr>
<tr>
<td>Pigmentation within necrotic or chlorotic areas</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Purple</td>
<td>x x x x</td>
<td>x x x x</td>
<td></td>
</tr>
<tr>
<td>Dark green</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Brown</td>
<td>x x</td>
<td></td>
<td>x x x x</td>
</tr>
<tr>
<td>Red</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Malformation of leaflets</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rolling in of margin</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wilting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Twisting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Malformation of leaves</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cupping</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Umbrella formation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Malformation of stems and roots</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Internode shortening</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Petiole collapse</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Root distortion</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Symptoms of nutrient disorders – faba beans & field peas, Snowball and Robson (1991), University of Western Australia. * = mild
Copper deficiency

**Description**
Older to middle leaves become mottled yellow to brownish pink, with dead tissue around the edges and tips. Light yellow-green spots form on the leaf.

Plants are shortened with wilting and puckering distortion of new leaflets. Shrivelling of the leaf tip and aborted flowers.

It is worse on highly alkaline soils, very infertile siliceous sands and soils with a low zinc fertiliser history.

**Management**
Leaf tissue tests will determine the plant’s copper status at sampling.

Apply copper at seeding in fertiliser, by liquid injection, on the seed or as a foliar application.

(Above) Early symptoms of wilting in new leaves of copper deficient plants.

(Right) Withertip in fully opened leaves of copper deficient plants.

Images: A Robson, University of Western Australia
Iron deficiency

Description
Often appears in young plants. Is related to soil type where there is a high lime content in cold wet conditions. Plants often recover as conditions warm.

Deficiency shows up as chlorotic leaves and poor growth. New leaves and young growth become yellow, causing smaller and unfolded leaves. Chlorotic leaves roll along their margins of barely opened leaflets. Deficiency then spreads to older leaves, and young growth stops. Stems become slender and shortened.

Management
Iron deficiency can be transient, and foliar iron applications may not necessarily be absorbed into the leaf if symptoms are severe.

Use a more tolerant variety.

Avoid high pH calcareous soils.

Image: W Hawthorne, Pulse Australia
Manganese deficiency

Description
Common on highly alkaline calcareous soils. Worse on fluffy soils with wheel tracks not as badly affected.

- Yellowing between the veins of younger leaves, often in specks. Purple spotting of fully and partially opened new leaves and even unopened leaves.
- Many affected new leaves show distortion as if the margins are growing at different rates, resulting in twisted leaves.

Deficiency late in the season may lead to discolouration, splitting and deformity of seed.

Management
Leaf tissue tests will determine the plant’s manganese status at sampling.

- Apply manganese at seeding in fertiliser, by liquid injection, on the seed or as a foliar application.

*Images: N Wilhelm, SARDI; A Robson, University of Western Australia*
Potassium deficiency

Description
Older leaves exhibit deficiency symptoms first. Initially shows as stunted growth, particularly if compared with other areas of the paddock with soil of higher potassium levels (e.g. burnt windrows).

Lower leaves exhibit greying leaf margins and eventually shrivel and die. Also cupping of leaves and some purple blotching across leaves.

Management
Determine availability of potassium with a soil test. Apply potassium in fertiliser. Apply clay and organic matter to sandy soils to increase the capacity to hold nutrients such as potassium. Apply potassium 6 to 8 weeks after sowing.

Images: W Hawthorne, Pulse Australia
Zinc deficiency

Description
Older to middle leaves become mottled yellow to brownish pink, with dead tissue around the edges and tips.

Plants are shortened with wilting and distortion of older leaflets.

Worse on highly alkaline soils, very infertile siliceous sands and soils with a low zinc fertiliser history.

Management
Leaf tissue tests will determine the plant’s zinc status at sampling.

Apply zinc at seeding in fertiliser, by liquid injection, on the seed or as a foliar application. Soil applied zinc should be re-applied every 2–7 years depending on soil type.

A response to applied zinc requires adequate phosphorus levels to be present.

Images: W Hawthorne, Pulse Australia; R Graham, University of Adelaide; A Robson, University of Western Australia
Nodulation failure

Description
Plants become yellow or pale green with restricted growth, especially when rapid growth after cold wet periods through the seedling stages. Oldest leaves are the worst affected.

There are few or no nodules on the roots, or nodules lack red pigmentation inside.

Plants can appear normal until flowering on soils with moderate to high nitrogen levels when they become pale green. Older leaves are affected most and first.

Management
As a salvage operation, apply nitrogen needs of affected crops with N fertiliser if economic. Ensure future crops are adequately inoculated with viable Group F inoculum.

In assessing the effectiveness of nodulation, the more nodules and the earlier the infection (i.e. on the tap and crown roots) the better. Nodules need to be pink to be effective.

<table>
<thead>
<tr>
<th>Nodule score</th>
<th>Distribution and number of effective nodules</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Crown/ Tap root</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0.5</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>1.5</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>Few</td>
</tr>
<tr>
<td>2.5</td>
<td>Few</td>
</tr>
<tr>
<td>3</td>
<td>Many</td>
</tr>
<tr>
<td>4</td>
<td>Many</td>
</tr>
<tr>
<td>5</td>
<td>Many</td>
</tr>
</tbody>
</table>

Images: W Hawthorne, Pulse Australia; TBretag, formerly VDPI

Poorly nodulated plants are stunted and pale green, compared to well nodulated plant in centre.

Images: W Hawthorne, Pulse Australia; TBretag, formerly VDPI

Good nodulation on root left; poor nodulation on right.
Drought

Description
Lack of growing season rainfall can lead to poor establishment, growth and very short crops resulting in difficulties harvesting.

A dry spring after adequate rains in winter can lead to poor yields with poor grain fill and smaller grain.

Warm windy weather with dry conditions in spring can result in reduced flower set, poor grain fill, smaller grain and low yield.

Management
Sow early in the sowing period in early maturing areas.

Sow earlier maturing varieties.

Retain stubble cover from previous crops (standing or mulch) to minimise moisture loss.

Control summer weeds.

Image: W Hawthorne, Pulse Australia

Withering and lack of podset resulting from a dry hot spring.
Frost

Description
Faba bean plants can tolerate frost during vegetative stages, but severe frosts can deform stems and cause lodging.

Frost during flowering and podding can cause significant yield loss and damage to grain. Plants will drop flowers and abort setting pods. Immature grain is prevented from further development. Leaf edges, flowers, pods and immature seeds may be black. Stems and leaves can blister and distort.

Milder frosts blacken developing seeds, with all seeds in a pod not necessarily affected. Pods are puffy and the outer layer of skin tends to lift producing a mottled appearance. In severe frost, stems weaken and bend (split). Plants are generally not killed. Grain that is nearly mature may become discoloured and distorted.

Management
Avoid sowing in areas particularly prone to severe frost damage. Choose sowing dates or variety maturity to reduce the risk of frost. Roll or clay sandy surfaced soils. Maintain adequate nutrition. Sowing in a north-south direction and sowing down hill to channel cold air away may reduce frost risk. Wider row spacing may increase frost risk.

Images: M Ramsey, formerly SARDI; W Hawthorne, Pulse Australia
Hail

Description
During the vegetative stage hail can shred leaves and slow crop development. Stems can be severely bruised or cut off completely. Stem breakage or bruising is often on one side.

Later, it can remove flowers and pods or flatten crops making them hard to harvest and pods can shatter in mature crops reducing yields severely.

Hail usually damages a swathe through the crop.

Management
Offset risk in prone areas with a range of crops and varieties maturing at differing times.

Invest in adequate hail insurance.
Necking and lodging

Description
Strong wind events during flowering through grain fill can result in necking or lodging. Necking damage appears as the top third to half of plants bent sharply up to 180 degrees. Lodging can occur with strong wind as the plants near maturity and stems become tougher, so that the plant leans from the base or crown. In extreme cases, plants may be flattened entirely or the stem broken. Necking can restrict seed fill.

Necking or lodging prior to flowering can increase foliar disease or shade flowers leading to flower abortion and reduced seed set through disease, less light or reduced access by pollinators.

Lodging near maturity make beans slower and more difficult to harvest with greater grain losses. Harvest direction may have to be adjusted to pick up the lodged crop.

Management
Grow varieties with greater resistance to lodging. These are likely to be the shorter more erect types.

Sow later to match sowing time with the environment in which it is grown, so as not to grow excessive bulk and to avoid moisture stress at maturity.

Harvest early, prior to wet or windy weather as delays lead to even greater lodging. Crop lifters will aid harvesting lodged crops.

Images: W Hawthorne, Pulse Australia; T Yeatman, Rural Solutions SA
**Waterlogging**

**Description**
Plants can show symptoms of iron and or nitrogen deficiency.

Plants can appear to survive waterlogging, but quickly die after the soil dries.

Root systems are shallow and blackened with root rots.

**Management**
Avoid poorly drained soils and areas prone to waterlogging.

Improve drainage and movement of water away from the faba bean paddock.

Sow early to ensure emergence and adequate growth before water lays.

Delay sowing in higher rainfall areas.

Sow into raised beds or into hilled soil.

*Images: W Hawthorne, T Bray, Pulse Australia; GRDC*
Weather damaged grain

Description
Weather damage is a general term to describe visible damage to the seed coat or kernel due to some form of weather event prior to harvest. Weather damage may lead to poor colour, loose seed coat, sprouting, wrinkling or other defects.

Wrinkled seed – arises from stress during the maturation phase that causes damage to the seed coat. The seed coat must be significantly indented into the kernel as coarse rather than soft waves.

Loose seed coat – caused by weather conditions such as rain near harvest or poor handling or harvesting techniques. It results in breakage or cracking of the seed coat that might be separated from the kernel or about to separate.

Shrivelled seed – arises from some form of stress during the maturation phase. Seed coats may be wrinkled, significantly indented into the kernel and tightly adhere to the kernel. Grains are often smaller than the majority of the sample.

Management
Desiccate or windrow beans and harvest them as early as possible.

Images: Pulse Australia
Bluegreen aphid (*Acyrthosiphon kondoi*)

**Description**
Adults are 3 mm long, may have wings; vary from grey-green to blue-green; have two long siphuncles that extend beyond the base of the abdomen. They are normally found on the upper part of the plant, particularly on growing points. Nymphs are similar but smaller in size.

They can vector plant virus diseases. Adults and nymphs suck sap causing misshapen leaves, yellowing and stunting. Honeydew and black sooty mould can occur with high numbers.

**Management**
This pest is more common in cooler months but check all stages of the crop.

Apply an aphicide when necessary to avoid economic damage. A border spray can provide sufficient control earlier in the season when aphids move into crop edges.

**Biocontrols**
Aphid diseases, aphid wasp parasites, ladybird beetles, hoverflies and lacewings.
**Cowpea aphid** (*Aphis craccivora*)

**Description**
Adults are shiny black, up to 2 mm long, may have wings and are shiny black. Nymphs are dull grey. All stages have white and black legs. They form dense colonies on the growing points of a single plant before moving onto other surrounding plants.

Heavy infestations deform leaves, growing points and stunt plants. Very dense colonies may cause visible wilting and severe yield loss. Honeydew and black sooty mould can occur with high numbers. They can spread many plant viral diseases.

**Management**
Check all crop stages especially during flowering. Apply an aphicide when necessary to avoid economic damage. A border spray can provide sufficient control earlier in the season when aphids move into crop edges.

**Biocontrols**
Aphid diseases, aphid wasp parasites, ladybird beetles, hoverflies and lacewings.
Pea aphid *(Acyrthosiphon pisum)*

**Description**
Adults are 4 mm long, may have wings; yellow, green or pink in colour. Nymphs are similar but smaller in size. All stages have dark coloured knees and dark joints on their antennal segments.

Adults and nymphs suck sap causing misshapen leaves, yellowing and stunting. Honeydew and black sooty mould can occur with high numbers. They can spread plant viral diseases.

**Management**
This pest is more common in cooler months but check all stages of the crop. Apply an aphicide when necessary to avoid economic damage. A border spray can provide sufficient control earlier in the season when aphids move into crop edges.

**Biocontrols**
Aphid diseases, aphid wasp parasites, ladybird beetles, hoverflies and lacewings.
INSECT PESTS — Moths and caterpillars

Cutworms (common cutworm or bogong moth, black cutworm, brown or pink cutworm and herringbone cutworm)  
(*Agrotis infusa, Agrotis ipsilon, Agrotis munda* and other *Agrotis* species)

**Description**
Larvae are hairless and appear greasy, have dark heads and usually darkish coloured bodies. They are up to 50 mm long, curl up and remain still if disturbed. Larvae live and pupate in the soil and emerge at night to feed at or near ground level, on the leaves or stem. Large larvae often cut through the stems of young seedlings, hence the name “cutworms”.

*Agrotis infusa* (common or bogong) larvae are black, green-brown or grey. They are sporadic pests that cause damage in late winter and early spring. Moths vary from dull dark brown to black and have a wingspan of 30–50 mm. Moths emerge in late spring or early summer and are often observed entering houses and buildings for shelter over summer.

Images: SARDI; DAFWA
A. *munda* (brown or pink cutworm) larvae are greyish-green to brown without distinct markings, becoming darker as they mature. Moths are light to dark brown with a wingspan of 30–40 mm and have one or two generations per year. Forewings have a grey-brown pattern and hindwings are whitish. Moths of other *Agrotis* species are usually a dull brown-black in colour. Herringbone cutworm larvae have diagonal markings along their body.

**Management**
Check crops from emergence through to establishment. Damage is often patchy. Larvae are usually just beneath the soil surface during the day and emerge to feed at night. Check the base of healthy or recently damaged plants adjoining damaged, bare or thin areas.

**Biocontrols**
Orange caterpillar parasite, two-toned caterpillar parasite, orchid dupe, caterpillar fungal diseases, spiders and *Bacillus thuringiensis* (Bt).
Brown pasture looper (*Ciampa arietaria*)

**Description**
Larvae are up to 25 mm long, dark brown to grey with a yellow line along the back either side of a conspicuous dark band. A red colouration surrounds the spiracles (breathing holes) on the sides of their body. Larvae move with a looping action except when mature. Moths are 20 mm long and are pale dusty-brown with grey and brown streaking on the forewings. Wings are held over the body at rest. One generation occurs per year.

Larvae feed on leaves, usually from July to October. Older larvae can move in large numbers into crops from adjoining pastures, resulting in severe defoliation.

**Management**
Check crops after establishment particularly around the perimeter of the crop. High numbers can be found on broad leaf weeds, particularly capeweed.

**Biocontrol**
Glossy shield bug, spined predatory shield bug and caterpillar egg parasites.

*Images: SARDI; DAFWA*
Looper caterpillar (*Chrysodeixis* sp.)

**Description**
Larvae have a predominantly green body that tapers towards the head. Newly hatched larvae have dark heads. Older larvae have white lines running the length of the body and are up to 35 mm long. Larvae move with a distinctive looping action and have two pairs of abdominal prolegs. Moths are up to 40 mm long, mottled grey or brown with distinct silvery and irregular shaped markings on the forewings. Several generations occur from autumn to spring.

Larvae feed on leaves leaving large holes.

**Management**
Larvae may be noticed when checking for other pests but do not require special attention.

**Biocontrol**
Glossy shield bug, spined predatory shield bug, tachinid flies, orange caterpillar parasite, two-toned caterpillar parasite, orchid dupe, *Bacillus thuringiensis* (Bt) and *Nuclear polyhedrosis virus* (NPV).

Images: DAFWA; P Reid, QPIF
Native budworm and corn earworm or cotton bollworm
(*Helicoverpa punctigera* and *Helicoverpa armigera*)

**Description**
Larvae of both species grow to 40 mm long with considerable colour variation (usually shades of brown, green and orange) with lines and bands running along the length of the body. The body is sparsely covered with small bumps, bristles and long stiff black hairs. Newly hatched larvae are 1–2 mm in length, light in colour with tiny dark spots and dark heads. As larvae develop they become darker and the darker spots more obvious. Both species of *Helicoverpa* have four pairs of abdominal prolegs in addition to a pair of anal prolegs.

Larvae typically feed high up on plants with their heads buried in buds, flowers, fruiting parts and seeds. Less serious damage occurs when larvae chew on leaves. Larvae of all sizes damage seed pods.

*H. armigera* have white hairs around the head, medium larvae have a saddle of darker pigment on the fourth abdominal segment (see photo) and dark coloured legs. *H. punctigera* have black hairs around the head; medium larvae have no saddle and light coloured legs.
Moths have a wing span of 30 mm, forewings are buff olive to red brown with dark spots and blotches near the edge. *H. punctigera* are pale with a uniform dark band along the lower edge of the hindwing, while *H. armigera* have a small light or pale patch in the dark band.

Eggs are 0.5 mm in diameter and change colours from white when laid, to brown and then to a black before hatching. *H. punctigera* is more common in the southern region than *H. armigera*.

**Management**

Eggs are most commonly laid on the top third of the plant and growing points. Closely monitor crops for larvae from budding and flowering through to maturity. A sweep net should be used from early flowering and throughout podding in pulse crops.

**Biocontrols**

On larvae – glossy shield bug, spined predatory shield bug, damsel bug, assassin bug, tachinid flies, orange caterpillar parasite, two-toned caterpillar parasite, orchid dupe, Bt, NPV, caterpillar fungal diseases, lacewings and spiders. On eggs – damsel bug, caterpillar egg parasites, ladybird beetles, lacewings and spiders.

*Helicoverpa* damage to beans (*right*).

*Helicoverpa* damage with undamaged grain on left.
Onion maggot (*Delia platura*)

**Description**
Maggots are typical fly larvae up to 7 mm long, cream with a thickened tail, and tapering front end with visible dark mouthparts. Adult flies are about 5 mm long, similar to the bush fly but more slender, hairy and wings greyer in colour.

Larvae tunnel just under the soil surface of the stem and root, often causing death of the plant in association with rotting organisms. Damage may appear similar to root rot until split open to reveal the maggot.

**Management**
Check crops at emergence and early growth.

Crops sown into paddocks with large quantities of plant stubble and debris will be more at risk.

More severe damage may be seen on previous year’s stubble rows.

*Images: SARDI; PaDIL*
**Balaustium mite** (*Balaustium medicagoense*)

**Description**
Adults grow up to 2 mm long, are variable in colour but mainly dark red-brown, with characteristic short stout hairs covering the body. They have eight red coloured legs. Newly hatched nymphs have six legs and are bright orange in colour.

Mites feed on the leaves of plants by probing into the surface cells with their mouth parts, and sucking out sap. Leaves may become bleached with high mite numbers, but plants are usually able to outgrow the damage. In severe cases plants will be retarded or die.

Crops sown into paddocks with high levels of broad leaf weeds, especially capeweed will be most at risk from mite damage.

**Management**
Check crops from March to early December, particularly in paddocks with a history of chemical treatments for redlegged earth mites. They have been shown to be more tolerant than RLEM to a range of synthetic pyrethroids and organophosphates.
Blue oat mite (**Penthaleus** spp.)

**Description**
Adults are 1 mm long and have eight red-orange legs. They can be identified by their dark blue-black bodies with a distinct oval red/orange spot on the back. They generally feed singularly. This pest is active from autumn to late spring and is widely distributed across southern Australia.

Feeding causes a silver or white discolouration of leaves and distortion or shriveling if severe. Mites are most damaging to emerging crops, greatly reducing seedling survival and development.

**Management**
Check paddocks prior to sowing in autumn and throughout winter. Examine plants for damage and search for mites on leaves and on the ground, especially in late sown crops.

Some *Penthaleus* species are more tolerant than RLEM to a range of synthetic pyrethroid and organophosphate insecticides.

**Biocontrols**
The French anystis mite is an effective predator but limited in distribution. Snout mites also prey upon this pest and help keep populations in check.
Clover mite or bryobia mite (*Bryobia* spp.)

**Description**
Adults are about 0.75 mm in length, have an oval shaped and flattened body. They have a brown to fawn-orange body and eight pale orange legs. The front legs are 1.5 times the length of their body. They are most active in warm conditions in autumn, spring and early summer. They are generally found in low numbers over the winter period. Summer rains followed by warm mild autumns give them the best conditions for survival and increase.

These mites feed on the upper surfaces of the leaf by piercing cells and sucking out the contents. They cause distinct whitish grey feeding trails on cotyledons and leaves. Attack on newly emerged leaves can result in discoloured leaves, which fail to grow.

**Management**
Mites are difficult to find in wet conditions. Check during the warmer part of the day when they are most active. Look for damage and their presence on clovers and *Brassica* weeds before sowing. Examine crops at emergence. Control summer weeds early in paddocks to be cropped to prevent the build up of mites.

If in large numbers, incorporation of insecticide with herbicide immediately prior to sowing is more effective than spraying when the crop is emerging and has very little cover of green material. Organophosphate based chemicals reportedly control *Bryobia* better than synthetic pyrethroids. Chemical rates commonly used to control RLEM are generally not effective against *Bryobia* mites.
Redlegged earth mite (*Halotydeus destructor*)

**Description**
Adults are 1 mm long and have eight red-orange legs. Adults and nymphs have a velvety black body. Newly hatched mites are only 0.2 mm long, pinkish-orange with six legs. Redlegged earth mites are generally active from autumn to late spring feeding in large groups up to 30 individuals. They are found in southern Australia, but not northern NSW.

They also feed on a range of weed species including Paterson’s curse, ox-tongue and capeweed. Feeding causes a silver or white discolouration of leaves and distortion or shrivelling in severe infestations. Affected seedlings can die at emergence with high mite numbers.

**Management**
It is especially important to inspect crops regularly in the first three to five weeks after sowing. They will drop to the ground and seek shelter if disturbed during feeding. They will crawl into cracks in the ground to avoid heat and cold. Mites are best detected feeding on the leaves in the morning or on overcast days. In the warmer part of the day redlegged earth mites tend to gather at the base of plants, sheltering in leaf sheaths and under debris. Foliage sprays applied once the crop has emerged are generally an effective method of control.
Biocontrols
At least 19 predators and one pathogen are known to attack earth mites in eastern Australia. Minimise the chemical impact on predator species by choosing a spray that has least impact and by reducing the number of chemical applications.

The French anystis mite is the most effective predator but is limited in its distribution. Snout mites will also prey upon this pest and help keep populations in check.

Using cultural control methods can decrease the need for chemical control. Rotate crops or pastures with non-host crops or cultivation to reduce numbers.

Feeding damage to canola seedlings.

Redlegged earth mite damage to a faba bean seedling.

Images: CESAR; A Mayfield, Allan Mayfield Consutling
Lucerne flea (*Sminthurus viridis*)

**Description**
Adults and nymphs are yellow-green, and can have dark markings. Adults are up to 3 mm in length, wingless and globular in shape. They spring off vegetation when disturbed using a special organ under the body. Mostly found on loam and clay soils.

Although a serious pest of young crops, they can also damage older crops. They work up plants from ground level leaving distinctive transparent “window” damage on the leaves. A severe infestation may remove all green material. They are present from autumn to spring. Numbers tend to peak in late spring. They are favoured by high humidity and moisture, a mild autumn and winter and a wet spring the previous year.

**Management**
Regularly check for damage from autumn to spring. Control is generally achieved with organophosphate insecticide. They are more tolerant to a range of synthetic pyrethroids. When mites are also present, use a product to control both pests. A border spray will stop invasion from neighbouring paddocks.

Treat approximately three weeks after lucerne flea first infests the crop. This will allow over-summering eggs to hatch but prevent adults laying winter eggs. Damage is worse following a weedy crop or pasture in which lucerne flea have not been controlled. Control is recommended the season prior to sowing faba beans.

**Biocontrols**
Pasture snout mites and spiny snout mites prevent outbreaks of this pest when in sufficient numbers.
Onion thrips, plague thrips and western flower thrips
(*Thrips tabaci, Thrips imaginis and Frankliniella occidentalis*)

**Description**
Adults are 2 mm long, cigar-shaped and range in colour from yellow-orange to dark grey. They have tiny, narrow wings carried over the back. Nymphs are similar in shape, pale yellow to orange-yellow, wingless and smaller in size. Species differentiation is extremely difficult in the field.

Adults and nymphs pierce plant tissue and suck sap. Their impact on crops is minimal, even with occasionally high numbers. Damage can occur in dry weather during flowering.

Flower buds can be badly damaged causing flowers and very small pods to shed.

They cause whitish blotches on leaves. Black flecks on leaves (excreta), can be easily rubbed off. Can cause reddening of leaf petiole and veins in beans.

**Management**
Check seedling and flowering crops. Shake flowers over a white surface or container to dislodge thrips.
**Mandalotus weevil** (*Mandalotus spp.*)

**Description**
Adults are 3–5 mm long, round and dull brown in appearance resembling small clods of dirt. Occurs mainly on rubbly, lighter or calcareous soil types. Commonly found in the mallee districts of southern Australia, but can be found in other regions. Little is known about their life cycle. One generation a year.

Adults actively feed at night on leaves of young seedlings resulting in scallop shaped notches. In severe cases seedlings are often ring-barked at ground level causing them to drop. During the day they hide under clods of dirt and trash.

**Management**
Major damage occurs after emergence and crops should be regularly inspected. Monitoring and control should be conducted at night when adults are most active.

*Images: CESAR; C Bell, formerly Rural Solutions SA*
All pest populations are regulated to some degree by the direct effect of other living organisms. A wide range of beneficial organisms can be grouped into three categories:

- **Parasites** – organisms that feed on or in the body of another, the host. Most eventually kill their host and are free-living as an adult (parasitoids) e.g. aphid wasp parasites.
- **Predators** – mainly free-living insects that consume a large number of prey during their lifetime e.g. shield bugs, lacewings, hover flies, spiders, predatory mites and predatory beetles.
- **Insect diseases** – include bacterial, fungal and viral infections of insects.

Integrated pest management (IPM) in its simplest form, is a management strategy in which a variety of biological, chemical and cultural control practices are combined to provide stable long-term pest control.

A key component of any IPM program is to maximise the number of beneficial invertebrates and incorporate management strategies other than pesticides that will help to keep pest insect numbers below an economic threshold.

Correct identification and regular monitoring is the cornerstone of IPM. When monitoring crops for insects, it is important to also check for the presence of, and record the build-up or decline in, the number of these beneficials to make the best insect control decisions.

Integrate other pest management practices together with the use of insecticides only where necessary to maximise the number of beneficial organisms. This will result in the better control of insect pest populations and a reduced reliance on the use of insecticide.
**Beetles**

- Carabid beetle, adult.
- Common ladybird, adult.
- Transverse ladybird, adult.

**Bugs**

- Damsel bug, adult.
- Damsel bug, nymph.
- Assassin bug, adult.
- Glossy shield bug, adult.
- Glossy shield bug, nymph.
- Spined predatory shield bug, adult.

*Images: SARDI; CESAR; J. Wessels, QPIF; DAFWA*
**Flies**
- Tachinid fly, adult.
- Hover fly, adult.

**Lacewings**
- (Above) Green lacewing, adult.
- (Right) Brown lacewing, adult.
- Lacewing, nymph.

**Mites**
- Snout mite next to redlegged earth mite and lucerne flea.
- French anystis mite attacking a redlegged earth mite.

**Spiders**
- Jumping spider.
- Hover fly, larva.

**BENEFICIAL ORGANISMS**

Images: SARDI; DAFWA; CEASAR
**Caterpillar wasps**

*Helicoverpa* larva being parasitised by an orange caterpillar parasite wasp.

Wasp larva on noctuid caterpillar.

*Telenomus* wasp parasitising *Helicoverpa* eggs.

*Trichogramma* wasp.

Two-toned caterpillar wasp parasite.

Banded caterpillar wasp parasite.

Orchid dupe.

Braconid wasp (*Microplitis demolitor*) parasitising a caterpillar larva.

**Aphid wasps**

*Aphidius ervi* on bluegreen aphid.

*Trioxyx complanatus* wasp.

Parasitised aphid (mummy on left).

Aphid mummy with parasite exit hole.

Images: D Ironside, QPIF; VDPI; P. Reid and C. Mares, QPIF; NSW Agriculture; SARDI; DAFWA; D Paul, University of Melbourne; CESAR
Insect diseases – viral and fungal

*Bacillus thuringiensis* (Bt) infected *Helicoverpa* larva

Noctuid larva showing typical v-shaped infection from *Nuclear polyhedrosis virus* (NPV).

Diseased aphids with parasitised aphid mummy (right).

Fungal diseased aphid.

Images: R Teakie, QPIF; DAFWA
Reticulated or grey field slug and black keeled slug
(Deroceras reticulatum and Milax gagates)

Description
The reticulated slug or grey field slug *D. reticulatum* is variable in colour, often light grey to fawn with dark brown markings. Slugs can grow to 50 mm long. A distinctive feature is that it secretes milky-white mucus when disturbed. It will reproduce at any time of the year if conditions, especially moisture, are suitable. Soils that retain moisture are most likely to harbour slugs. This species is mainly surface active.

The black keeled slug *M. gagates* is usually black with a sharp ridge or keel down the back, most obvious when the slug is disturbed and its body contracts. Slugs grow 40–60 mm in length. Is of relatively greater importance in drier areas, such as South Australia and western Victoria. It tends to burrow and feed on germinating seed embryos both on the soil surface and below the ground. Plants may fail to emerge, be eaten to ground level or irregular areas may be removed from leaves.
Management
Check paddocks before seeding or crop emergence, especially those with heavy soils or previous slug problems. Monitor slug numbers by placing refuges that retain moisture, such as tiles, on the soil surface at a number of sites across the paddock. Count the number under these refuges in mornings after moist conditions. To assess direct activity, crops should be checked on moist nights as they are emerging.

Biocontrol
Carabid beetles can play an important role in suppressing slug populations.

Images: CESAR; DAFWA; W Hawthorne, Pulse Australia
**Round or white snails** (*Theba pisana* and *Cernuella virgata*)

**Description**
Occur on alkaline soils across southern Australia.

White Italian snail *T. pisana* has a white coiled shell up to 30 mm in diameter, mostly with broken brown bands in the line of the spiral, although some are all white. The umbilicus is semi-circular or partly closed.

Vineyard or common white snail *C. virgata* has a white coiled shell up to 20 mm in diameter, mostly with continuous brown bands in the line of the spiral, although some are all white. Umbilicus is open and circular.

Feed on green plant material and dead organic material. Leaves are shredded by rasping mouthpart of *T. pisana* and emerging crops may be defoliated. Contamination of grain can clog harvesters and affect marketability. They over-summer off the ground on stubble, posts, etc and especially on green weeds and can become a major contaminant of grain.

<table>
<thead>
<tr>
<th>Snail</th>
<th>Snails over 7 mm/m²</th>
<th>Bait required kg/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Round or white snails</td>
<td>Less than 80</td>
<td>5</td>
</tr>
<tr>
<td>Conical snails</td>
<td>No threshold established</td>
<td>5</td>
</tr>
</tbody>
</table>

*Theba pisana*, partly closed umbilicus.
Management
Concentrate monitoring between January and April. Control tactics include stubble management (January and February), burning when fire restrictions permit and baiting in early April. Continue monitoring through the growing season to detect any snail movements, particularly from the edges of paddocks.

*Cernuella vergata*, note open circular umbilicus and continuous brown markings.

Images: DAFWA; SARDI

Rasping damage.
Pointed or conical snails (*Cochlicella acuta* and *Cochlicella barbara*)

**Description**
Occur on alkaline soils across southern Australia.

Pointed or conical snail *C. acuta* has a fawn, grey or brown conical shell up to 18 mm long. The ratio of the shell length to its base diameter is always greater than two.

Small pointed or small conical snail *C. barbara* has a fawn, grey or brown conical shell up to 10 mm long. The ratio of the shell length to its base diameter is always two or less. Most abundant in high rainfall areas.

Both species feed on dead organic material. Seedlings may be eaten by *C. barbara* to ground level when in high numbers and the very small shells can contaminate grain. They over-summer in leaf litter at the soil surface or just below surface and under stones and stumps, but can be found on posts and vegetation. Numbers increase in the pasture phase of cropping rotations.
Management
Concentrate monitoring between January and April. Threshold numbers for control for *C. barbara* in faba beans have not been established. Control tactics include stubble management (January and February), burning when fire restrictions permit and baiting in early April (*see page 105*).

Continue monitoring through the growing season to detect any snail movement, particularly from the edges of paddocks.

Biocontrol
Sarcophagid parasitic fly *Sarcophaga penicillata*.

Images: DAFWA

Conical snail infestation.
**Oedemas**

**Description**
Pods develop clear bumps on the outer surface which later turn black.

They are caused by insect feeding on the pods, e.g. thrips.

**Management**
Control sucking insects during podding.

*Image: M Ramsey, formerly SARDI*
Salinity

Description
Plants are stunted with yellowish discolouration followed by bright red pigmentation. Nodulation is poor or not present. Where severe, seedlings fail to emerge.

Where the water table rises after establishment, the crop stops growing, leaves drop and plants die.

Management
Avoid sowing on areas at risk.
Do not irrigate with saline water.
Faba beans cross pollinate with some self pollination, but require insect pollinators to maximise seed set. If low numbers of bees are present, introducing commercial pollinating bees through the crop in a grid of at least two hives/ha can increase yield by 30–100%.

Apiarists must manage hives as ‘pollinators’, not honey producers, placing hives throughout the crop, not in a paddock corner. Bees must be removed or housed when insecticide or fungicide is used.

Growers must tolerate bee hives through the crop but should see a yield benefit to pay for the pollination service. Apply and time chemical use wisely, use integrated pest management (IPM) and communicate intentions with the apiarist.

Well placed hives can increase yield 30-100%.

(Right) Yield range where hives 1.6–2.4 t/ha. Hives placed along black lines on map. Yield 0.8–1.5 t/ha in rest of paddock where no hives placed.

Images: W Hawthorne, Pulse Australia; R Kimber, SARDI; Danny Le Feuvre, Ag Consulting Co.
Desiccation to ensure even ripening of the crop and to ‘brown off’ late weed growth allowing earlier and easier harvest. Desiccation advances maturity up to 10 days. Spray once grains have reached physiological maturity, i.e. when the black hilum is apparent on grains in the bottom third of the plant; moisture is about 30%, usually 20–30 days after the end of flowering; the lower 75% of pods are turning black and seeds are firm with thin and leathery shells. Harvest 5 to 10 days after desiccation. Observe all withholding periods to avoid chemical residues in grain.

Crop topping timed to control seed set in escape weeds, normally ryegrass, also matures beans earlier. Earlier maturing varieties allow optimal timing and good control of weed seed set with minimal effect on yield. Crop topping too early, particularly in later maturing varieties, risks loss in yield and increased numbers of seeds with poor quality (darkened seed coats or small, green, immature seeds). Crop top as late as possible (i.e. dough stage of the ryegrass), when 50% or more bean seeds within the pods have changed from green to yellow.

Avoid using coloured foam markers which may stain bean seed through the pods.

Crop topping will be needed to prevent these ryegrass escapes setting seed.
Weed wiping cannot be successfully used in beans to prevent seed set of ryegrass and other tall weeds that stand above the crop. Unlike peas and lentils, bean crops are too tall for the ryegrass, even with the shortest variety.

Windrowed crop will survive better if harvest is delayed.

Windrowing can help achieve early harvest and the quality required by markets. Timing is as for desiccation. Set a maximum windrower width in bulky crops to avoid problems with windrowing, extended drying time or harvesting of excessively large windrows.

The advantages of windrowing beans are:

- Uniform maturity of the crop for harvest.
- Earlier harvest is possible at higher grain moisture content.
- Early harvest to avoid seed staining from late rains.
- Easier harvest with fewer losses where lodged.
- Less pod splitting and shattering if rain.
- Lower cutter bar height enabling lowest pods to be harvested.
- Late maturing weeds dried to enable earlier harvest.
- Better crop survival should harvest be delayed.
- Reduced snail contamination in the sample if windrowed late directly in front of the harvester.

Images: W Hawthorne, Pulse Australia; T Yeatman, Rural Solutions SA
Harvest timing

Faba and broad beans should be harvested as soon as they are ready. Windrowing, desiccation or crop topping enables even earlier harvest. When faba beans start to mature their leaves turn yellow then black and the pods and stems turn black. A black hilum is the best indication of grain maturity.

Harvest once the upper pods turn black and the stems are brittle enough to feed through the harvester. There are often still a few green parts scattered in the crop. Moisture content of the grain should be less than 13% at harvest to meet receival standards for storage. If too dry, cracking may occur with down graded quality as a consequence.

The lower pods are more prone to shatter than higher ones.

(Above) A black hilum is the best indication of maturity.

Faba beans starting to mature as their leaves turn yellow, then black and pods and stems turn black.

Images: T Yeatman, Rural Solutions SA; M Seymour, NSW DII
Tips for harvesting

- Harvest as soon as the beans are mature.
- Harvest early in the day or into evening; humidity reduces seed shatter; avoid damp, cool conditions.
- Beans just ripe for harvest can be harvested under warmer conditions than beans that have been left mature for some time.
- A flex front is ideal for beans.
- Crop lifters may be required with lodged beans.
- Avoid excessive harvest speed to minimise feeding problems.
- Use a desiccant for early harvest or if summer weeds would otherwise prevent timely harvest.

Harvesting problems are often associated with lodging, short crops with pods close to the ground or excessive harvest speed. Either crop lifters or a Draper type pick up front is needed to harvest the crop from windrows.

Image: W Hawthorne, Pulse Australia
Harvest for quality

Human food markets demand a quality sample without cracking, staining, de-hulled seeds or insect damage. Visual appearance is everything. Early harvest is important for quality. The large seed of beans make them prone to mechanical damage. Beans thresh readily, so minimise seed damage and losses during harvest by harvesting early morning, at low drum speed and with wide concave clearance.

Axial or rotary harvest drums cause less seed damage. Try a concave setting fully open at the front, and half closed at the back. Remove alternate wires and blanking off plates on the concave. Use maximum wind and wide sieve settings. Bean seed is heavy compared with stem and leaf trash, so use draft to remove trash. Where summer weeds, increase drum speed so they don’t block the machine. The rake at the back of the sieve may need to be turned off to stop weeds entering the returns.

Harvesting for seed

Choose an area of a paddock where there has been minimal disease, pest and weed infestation to ensure maximum germination and minimal weed and disease carryover. Ensure headers, bins, augers and other equipment are free of grain contaminants. The middle of the crop is likely to be the best area for seed production as weed and insect problems are usually worst at the edges.

Image: W Hawthorne, Pulse Australia

The large seed of beans make them prone to mechanical damage.
Faba beans are sold almost exclusively for human consumption in the Middle East. Quality is critical. Seed blemishes due to disease or weathering, broken or insect damaged grain are not acceptable. Beans that have darkened due to age or sunlight are less acceptable because of longer cooking times and perceived loss of freshness.

Broad beans are graded to size and exported whole in bags or containers. Larger grain sizes are often, but not always, more marketable, with smaller grades (e.g. less than 11mm) harder to sell and often lower priced than larger grades (e.g. 14mm).

Premium food quality markets are higher priced. Faba and broad beans are mainly consumed as whole product, but also as split product (dhal) or as flour. Some faba beans are exported as splits, and others go to canners in the Middle East (e.g. Dubai).

The broad bean market has been limited and can be over supplied. They are sold through processors and need to be machine dressed and graded to size. Price is usually based on proportions of grain above and below 11 mm and 14 mm screen sizes.
## National faba and broad bean market receival standards

<table>
<thead>
<tr>
<th>Receiving standard</th>
<th>Maximum moisture content (%)</th>
<th>Minimum purity (%)</th>
<th>Maximum defective including poor colour (%)</th>
<th>Screen size for defective (mm)</th>
<th>Poor colour defective maximum (%)</th>
<th>Maximum other defective (%)</th>
<th>Maximum insect damage (%)</th>
<th>Foreign material maximum in total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No 1 grade faba bean</td>
<td>14</td>
<td>97</td>
<td>6</td>
<td>3.75 slotted</td>
<td>3</td>
<td>3</td>
<td>–</td>
<td>3</td>
</tr>
<tr>
<td>No 2 grade faba bean</td>
<td>14</td>
<td>97</td>
<td>10</td>
<td>3.75 slotted</td>
<td>7</td>
<td>10</td>
<td>–</td>
<td>3</td>
</tr>
<tr>
<td>Broad bean</td>
<td>14</td>
<td>97</td>
<td>7</td>
<td>6.0 slotted</td>
<td>3</td>
<td>6</td>
<td>1.5</td>
<td>3</td>
</tr>
<tr>
<td>Unmillable material maximum</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Snail maximum</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insect maximum</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Nominated weed seed maximums (maximums for each type)

<table>
<thead>
<tr>
<th>Receiving standard</th>
<th>Unmillable material maximum</th>
<th>Snail maximum</th>
<th>Insect maximum</th>
<th>Nominated weed seed maximums (maximums for each type)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No 1 grade faba bean</td>
<td>0.5 (0.3% soil)</td>
<td>2 per 400 g</td>
<td>30 per 400 g</td>
<td>See footnote for weeds and amounts allowable</td>
</tr>
<tr>
<td>No 2 grade faba bean</td>
<td>0.5 (0.3% soil)</td>
<td>2 per 400 g</td>
<td>30 per 400 g</td>
<td>See footnote for weeds and amounts allowable</td>
</tr>
<tr>
<td>Broad bean</td>
<td>0.5 (0.3% soil)</td>
<td>2 per 400 g</td>
<td>30 per 400 g</td>
<td>See footnote for weeds and amounts allowable</td>
</tr>
</tbody>
</table>


**Defective grain:** not of the specified type, broken, damaged and split, grub eaten, sprouted, affected by mould and poor colour.

**Poor colour:** excessive seed coat discolouration – see Pulse Australia Faba and Broad Bean Photographic Charts. Includes Ascochyta lesions.

**Foreign material:** includes unmillable material and all foreign vegetable matter (includes cereals, wild oats, oilseeds, other legumes and weed seeds other than nominated foreign weeds listed in standards.

**Unmillable material:** includes soil, stones, metal and non-vegetable matter.
### Faba and broad bean market categories

<table>
<thead>
<tr>
<th>Type</th>
<th>Variety</th>
<th>Generalised market comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small size faba bean (&lt;50 g/100 seeds)</td>
<td>Doza*, Fiord, Barkool, Ascot VF</td>
<td>For splitting markets; generally considered too small for most whole bean markets.</td>
</tr>
<tr>
<td>Medium size faba bean (50–75 g/100 seeds)</td>
<td>Fiesta VF, Nura, Farah, Cairo, Doza*</td>
<td>Considered ideal for whole and splitting market, so long as not too many large beans or too variable in size.</td>
</tr>
<tr>
<td>Larger size faba bean (75–100 g/100 seeds)</td>
<td>Manafest Aquadulce#</td>
<td>Market acceptance, but a smaller sized market than the medium sized “Fiesta” type faba bean products.</td>
</tr>
<tr>
<td>Small size broad bean (90–120 g/100 seeds)</td>
<td>Aquadulce#</td>
<td>90–110 grade – small sized grain graded from broad beans or from broad beans grown in shorter season areas or seasons.</td>
</tr>
<tr>
<td>Medium size broad bean (110–135 g/100 seeds)</td>
<td>Aquadulce#</td>
<td>75–90 grade – medium sized grain graded from broad beans or from broad beans grown in medium-shorter season areas or seasons.</td>
</tr>
<tr>
<td>Large size broad bean (135–160 g/100 seeds)</td>
<td>Aquadulce#</td>
<td>65–75 grade – usually considered the ideal size for broad beans; premium often paid. Must not have excessive “ever-greens” (dark green seeds).</td>
</tr>
<tr>
<td>Very large size broad bean (160–220 g/100 seeds)</td>
<td>Taranto†</td>
<td>45–65 grade – considered large size for broad beans; premium paid if seed weight adequate (i.e. not large, flat ‘floaters’).</td>
</tr>
</tbody>
</table>

*Doza may fit the small or medium categories, depending on where it is grown.

#Small sized grades are obtained from areas with shorter growing seasons, or by grading and sizing.

†Taranto has large seed (mm) but is not necessarily heavy enough.
### Commercial buying and selling arrangements (current as of May 2009)

Varieties may be covered by Plant Breeders Rights (PBR). Many have different types of seed purchase agreements, royalty/marketing or levy arrangements that affect marketing and sale of seed. Check varietal arrangements and restrictions with the seed agent before purchase.

<table>
<thead>
<tr>
<th>Variety</th>
<th>PBR</th>
<th>Licensee or agency</th>
<th>Commercial partner</th>
<th>Seed supplying agents</th>
<th>Market restriction</th>
<th>Broad market type</th>
<th>EPR per tonne (incl GST)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ascot VF</td>
<td>Terminated</td>
<td>Univ. of Adelaide</td>
<td>Seedmark</td>
<td>None</td>
<td>None</td>
<td>Small faba</td>
<td>Nil</td>
</tr>
<tr>
<td>Aquadulce</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>Broad bean</td>
<td>Nil</td>
</tr>
<tr>
<td>Cairo</td>
<td>PBR</td>
<td>NSW DII</td>
<td>ABB Seeds</td>
<td>None</td>
<td>Faba</td>
<td>Faba</td>
<td>$3.30</td>
</tr>
<tr>
<td>Doza</td>
<td>PBR</td>
<td>NSW DII</td>
<td>ABB Seeds</td>
<td>ABB Seeds</td>
<td>None</td>
<td>Small faba</td>
<td>$3.63</td>
</tr>
<tr>
<td>Farah</td>
<td>PBR</td>
<td>Univ. of Adelaide</td>
<td>PlantTech</td>
<td>PlantTech</td>
<td>Nominated receivers</td>
<td>Faba</td>
<td>$3.30</td>
</tr>
<tr>
<td>Fiesta VF</td>
<td>Terminated</td>
<td>Univ. of Adelaide</td>
<td>PlantTech</td>
<td>None</td>
<td>None</td>
<td>Faba</td>
<td>Nil</td>
</tr>
<tr>
<td>Fiord</td>
<td>None</td>
<td>Univ. of Adelaide</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>Small faba</td>
<td>Nil</td>
</tr>
<tr>
<td>Icarus</td>
<td>Terminated</td>
<td>Univ. of Adelaide</td>
<td>Seedmark</td>
<td>None</td>
<td>None</td>
<td>Green faba</td>
<td>Nil</td>
</tr>
<tr>
<td>Manafest</td>
<td>None</td>
<td>Univ. of Adelaide</td>
<td>AWB Seeds</td>
<td>AWB Seeds</td>
<td>Nominated receivers</td>
<td>Large faba</td>
<td>$3.30</td>
</tr>
<tr>
<td>Nura</td>
<td>PBR</td>
<td>Univ. of Adelaide</td>
<td>AWB Seeds</td>
<td>AWB Seeds</td>
<td>None</td>
<td>Faba</td>
<td>$3.30</td>
</tr>
</tbody>
</table>

See pulse receival and export standards
Defective grain

Description
Cracked, broken and discoloured grain greatly affects classification and market appeal. Appearance of the sample is extremely important for human consumption markets.

Cracked and broken grain – Broken or loose seedcoats and broken grain can easily occur during harvest or poor grain handling.

Poor grain colour (seed or kernel) – Can be caused by premature ripening due to heat, drought or disease stress, harvesting immature seed (“green kernel”), delayed harvest, rain at harvest, disease, frosting and a dry hot finish. Prolonged wet weather pre-harvest may lead to poor colour, loose seed coat or wrinkled grain.

Management
Minimise disease, especially Ascochyta blight, chocolate spot and rust. Manage crop to lessen affect of frost or a dry finish. Crop top or desiccate at the right time.

Harvest as soon as ready, before rain and before grain moisture is too low. Harvest carefully and handle grain to minimise grain damage.

Store in good storage conditions. Do not store grain for long periods for human food markets.

Range of beans with Ascochyta blight and weather damage.

Images: Pulse Australia

(Above) Cracked and broken grain.
Belt shifters are recommended. Faba bean and especially broad bean can be damaged by augers. Minimise handling grain to limit physical damage. Run augers full and at a slower speed than for cereals. Avoid dropping the beans from great height.

Do not allow “pockets” of moisture to develop in storage. Sound sheds and silos are suitable storages. Bunkers need to be waterproof. Silo bags should only be considered as short term, temporary storage as discolouration of grain can occur, moisture can be difficult to handle, odours arise and bags can be holed by vermin, birds or pests.

Store seed and grain at no more than 13% moisture, unless aerated. Moving moist grain on a warm, windy, dry day between two silos will reduce moisture content by 1–2%. Dry them, cool them, store them in the dark, and sell them as quickly as possible.

Where grain insects are detected, fumigate with phosphine in a sealed silo. Extra costs are imposed at delivery points if live insects are found in a load.

Grain hygiene is critical. Contaminants such as insects, weeds or other grains are undesirable. Animal excreta, rodent carcasses, mouldy grain and odours are unacceptable. Check regularly for insects or mould.

Air movement in the bin during cold (A) and warm (B) periods.
<table>
<thead>
<tr>
<th>Term</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acidic</td>
<td>12</td>
</tr>
<tr>
<td><em>Acyrthosiphon kondoi</em></td>
<td>79</td>
</tr>
<tr>
<td><em>Acyrthosiphon pisum</em></td>
<td>81</td>
</tr>
<tr>
<td><em>Agrotis infusa</em></td>
<td>82</td>
</tr>
<tr>
<td><em>Agrotis ipsilon</em></td>
<td>82</td>
</tr>
<tr>
<td><em>Agrotis munda</em></td>
<td>82</td>
</tr>
<tr>
<td>Alkaline</td>
<td>11</td>
</tr>
<tr>
<td>Amino acid</td>
<td>59</td>
</tr>
<tr>
<td><em>Aphanomyces euteiches</em></td>
<td>33</td>
</tr>
<tr>
<td><em>Aphanomyces root rot</em></td>
<td>33</td>
</tr>
<tr>
<td><em>Aphanomyces</em> sp.</td>
<td>30</td>
</tr>
<tr>
<td>Aphid wasps</td>
<td>100</td>
</tr>
<tr>
<td><em>Aphidius ervi</em></td>
<td>100</td>
</tr>
<tr>
<td>Aphids</td>
<td>79</td>
</tr>
<tr>
<td><em>Aphis craccivora</em></td>
<td>80</td>
</tr>
<tr>
<td>Aquadulce broad bean</td>
<td>9, 119, 121</td>
</tr>
<tr>
<td>Ascochyta blight</td>
<td>14, 27, 34, 36</td>
</tr>
<tr>
<td><em>Ascochyta fabae</em></td>
<td>30, 34</td>
</tr>
<tr>
<td>Ascot VF</td>
<td>119, 121</td>
</tr>
<tr>
<td>Assassin bug</td>
<td>98</td>
</tr>
<tr>
<td><em>Bacillus thuringiensis</em> (Bt)</td>
<td>85</td>
</tr>
<tr>
<td><em>Balaustium medicagoense</em></td>
<td>89</td>
</tr>
<tr>
<td>Balaustium mite</td>
<td>89</td>
</tr>
<tr>
<td>Banded caterpillar wasp parasite</td>
<td>100</td>
</tr>
<tr>
<td>Bean leafroll virus (BLRV)</td>
<td>45</td>
</tr>
<tr>
<td>Bean yellow mosaic virus (BYMV)</td>
<td>44</td>
</tr>
<tr>
<td>Beet western yellows virus (BWYV)</td>
<td>45</td>
</tr>
<tr>
<td>Beetles</td>
<td>96</td>
</tr>
<tr>
<td>Beneficial organisms</td>
<td>97</td>
</tr>
<tr>
<td>Benzamides</td>
<td>52</td>
</tr>
<tr>
<td>Benzoic acids</td>
<td>55</td>
</tr>
<tr>
<td>Bipyridyls</td>
<td>58</td>
</tr>
<tr>
<td>Black cutworm</td>
<td>82</td>
</tr>
<tr>
<td>Black keeled slug</td>
<td>102</td>
</tr>
<tr>
<td>Blue oat mite</td>
<td>90</td>
</tr>
<tr>
<td>Bluegreen aphid</td>
<td>79</td>
</tr>
<tr>
<td>Bogong moth</td>
<td>82</td>
</tr>
<tr>
<td>Boron toxicity</td>
<td>27, 65</td>
</tr>
<tr>
<td><em>Botrytis cinerea</em></td>
<td>30</td>
</tr>
<tr>
<td><em>Botrytis fabae</em></td>
<td>36</td>
</tr>
<tr>
<td>Botrytis grey mould</td>
<td>30</td>
</tr>
<tr>
<td>Braconid wasp</td>
<td>100</td>
</tr>
<tr>
<td>Broad bean</td>
<td>8, 9, 119, 120</td>
</tr>
<tr>
<td>Broad bean wilt virus (BBWV)</td>
<td>44</td>
</tr>
<tr>
<td>Brown lacewing</td>
<td>99</td>
</tr>
<tr>
<td>Brown or pink cutworm</td>
<td>82</td>
</tr>
<tr>
<td>Brown pasture looper</td>
<td>84</td>
</tr>
<tr>
<td><em>Bryobia</em> mite</td>
<td>91</td>
</tr>
<tr>
<td><em>Bryobia</em> spp.</td>
<td>91</td>
</tr>
<tr>
<td>Bugs</td>
<td>98</td>
</tr>
<tr>
<td>Buying and selling arrangements</td>
<td>122</td>
</tr>
<tr>
<td>Cairo&lt;sup&gt;(&lt;i&gt;b&lt;/i&gt;)&lt;/sup&gt;</td>
<td>119, 121</td>
</tr>
<tr>
<td>Carabid beetle</td>
<td>98</td>
</tr>
<tr>
<td>Carbendazim</td>
<td>31</td>
</tr>
<tr>
<td>Carotenoid biosynthesis</td>
<td>53</td>
</tr>
<tr>
<td>Caterpillar wasps</td>
<td>100</td>
</tr>
<tr>
<td>Cercospora leaf spot</td>
<td>27, 35, 37</td>
</tr>
<tr>
<td><em>Cercospora zonata</em></td>
<td>30, 35</td>
</tr>
<tr>
<td>Cernuella virgata</td>
<td>104</td>
</tr>
<tr>
<td>CESAR</td>
<td>.6</td>
</tr>
<tr>
<td>Chemical leaf spotting</td>
<td>60</td>
</tr>
<tr>
<td>Chickpeas</td>
<td>30</td>
</tr>
<tr>
<td>Chloracetamides</td>
<td>57</td>
</tr>
<tr>
<td>Chlorothalonil</td>
<td>31</td>
</tr>
<tr>
<td>Chocolate spot</td>
<td>27, 36, 38</td>
</tr>
<tr>
<td><em>Chrysodeixis</em> sp.</td>
<td>85</td>
</tr>
<tr>
<td>Ciampa arietaria</td>
<td>84</td>
</tr>
<tr>
<td>Climate</td>
<td>11</td>
</tr>
<tr>
<td>Clopyralid herbicide</td>
<td>27, 55</td>
</tr>
<tr>
<td>Clover mite</td>
<td>91</td>
</tr>
<tr>
<td>Clover yellow vein virus (CYVV)</td>
<td>44</td>
</tr>
</tbody>
</table>
INDEX

Cochlicella acuta .......................... 106
Cochlicella barbara ........................ 106
Common cutworm ........................ 82
Common ladybird ........................ 98
Copper ......................................... 31
Copper deficiency .......................... 67
Corn earworm ............................... 86
Cotton bollworm ............................ 86
Cowpea aphid ................................ 80
Crop development .......................... 24
Crop establishment ........................ 16
Crop topping ................................. 112, 114
Cross infection .............................. 30
Crown rot ..................................... 26
DAFWA .......................................... 6
Damsel bug .................................... 98
Defective grain .............................. 121
Deficiencies .................................. 66
Delia platura .................................. 87
Deroceras reticulatum ....................... 102
Desiccation .................................. 112, 114
Dinitro-anilines ............................. 52
Diphenylethers .............................. 54
Disease management ...................... 28
Disease prediction ......................... 29
Ditylenchus dipsaci ......................... 30
Downy mildew .............................. 27, 38, 40
Doza(b) ........................................ 9, 119, 121
Drought ........................................ 73
Farah(b) ........................................ 9, 119, 121
Fat synthesis .................................. 56
Field peas ...................................... 30
Fiesta VF ....................................... 119, 121
Fiord ............................................. 119, 121
Flies .............................................. 87
Frankliniella occidentalis .................. 95
French anystis mite ......................... 99
Frost ............................................. 27, 75
Fungicide guide ............................ 31
Fusarium sp. .................................. 30
Glossy shield bug ............................ 98
Glycines ....................................... 59
GRDC ........................................... 6
Green lacewing ............................. 99
Group B ........................................ 26, 50
Group C ........................................ 51
Group D ........................................ 52
Group F ........................................ 27, 53
Group I .......................................... 27, 55
Group J ........................................ 56
Group K ........................................ 57
Group L ......................................... 58
Group M ........................................ 27, 59
Gypsum ........................................ 13
Hail .............................................. 27, 76
Halotydeus destructor ....................... 92
Handling and storage ...................... 123
Harvest for quality ......................... 116
Harvest timing .............................. 114
Harvesting .................................... 112
Harvesting for seed ......................... 116
Helicoverpa armigera ....................... 86
Helicoverpa punctigera ...................... 86
Herbicide damage ......................... 48
Herbicide injury ............................. 49
Herbicide resistance ....................... 62
Herringbone cutworm ...................... 82
Hover fly ....................................... 99
Icarus .......................................... 122
Imidazolinones .............................. 50
Infection sources ........................... 29
Inoculation .................................... 22
Insect diseases .............................. 101
Insect pests ................................... 79
Introduction ................................... 6
Iron deficiency ................ 26, 68
Irrigation .................... 13
Jumping spider .............. 99
Lacewings .................... 99
Lentils ....................... 30
Lodging ...................... 76
Looper caterpillar .......... 85
Loose seed coat ............. 78
Lucerne flea .................. 94
Lupins ....................... 30
Manafest .................... 9, 119, 121
Mancozeb .................... 31
Mandalotus spp. ............. 96
Mandalotus weevil .......... 96
Manganese deficiency ...... 26, 69
Market broad categories .. 119
Marketing .................... 118
Microplitis demolitor .... 100
Milax gagates ............... 102
Mites ......................... 89
Mosaic viruses .............. 26, 45
Moths and caterpillars ...... 82
Native budworm ............ 27, 86
N-diphenylphthalamides .. 54
Necking ...................... 76
Nicotinanalides ............. 53
Nitrogen ..................... 10, 65
Nitrile ....................... 51
Nodulation failure ........ 26, 72
NSW DII ..................... 6
Nuclear polyhedrosis virus (NPV) .................. 85
Nura(1) ....................... 119, 121
Nutrition management ...... 64
Oedemas ..................... 27, 108
Onion maggot ............... 87
Onion thrips ................ 95
Optimum sowing times .. 19
Orange caterpillar parasite wasp .................. 100
Orchid dupe ................. 100
Other disorders .............. 108
Paddock selection .......... 10
PaDIL ......................... 6
Pea aphid .................... 81
Pea seed-borne mosaic virus (PSbMV) .......... 44
Penthaleus spp. ............. 90
Peronospora vicia .......... 38
Phenoxycarbolic acids ... 55
Phenyl-pyridazine .......... 51
Phoma sp. .................... 30
Phosphorus .................. 65
Photosynthesis .............. 51
Picolinamide ................ 53
Plague thrips ............... 95
Plant density ................. 17
Pointed or conical snail ... 106
Pollination .................. 110
Potassium deficiency ...... 70
PreDicta™ B ................ 29
Procymidone ................. 31
Protoportphyrinogen ...... 54
Pyridines .................... 55
Pyrimidindione ............. 54
Pythium sp. ................ 30
QPIF ......................... 6
Rainfall ...................... 11
Receival standards ......... 120
Redlegged earth mite ...... 26, 92
Reticulated or grey field slug 102
Rhizoctonia ................. 30, 39
Rolling ...................... 23
Root rots .................... 26, 30, 39, 41
Rotation ..................... 10
Row spacing ................ 21
Rust ........................................27, 42
*S. trifoliorum* ..........................41
Salinity ..................................109
SARDI ..................................6
*Sclerotinia sclerotiorum* ............41
*Sclerotinia* spp. .......................30
Sclerotinia stem rot .....26, 41, 42
Seed selection .......................15
Shrivelled seed .....................78
Slugs and snails .....................102
Small pointed or small conical snail .................106
*Sminthurus viridis* .................94
Snout mite ..........................99
Soil ..................................12
Sowing depth .......................20
Sowing rate .........................17
Spiders ................................99
Spined predatory shield bug ...98
Spraying ..............................32
Springtails ............................94
Stem nematode ......................30
Stubble ...............................10
Subterranean clover stunt virus (SCSV) .........45
Subterranean clover redleaf virus (SCRLV) .......45
Two-toned caterpillar wasp parasite ..........100
Urea ....................................51
*Uromyces viciae-fabae* ..............
Variety ................................14
VDPI ..................................6
Vicia faba ...........................8, 25
Vineyard or common white snail ..........104
Viruses ................................43
Waterlogging .......................12, 26, 77
Weather damage ....................73, 78
Weed control .........................47
Weed management ..................46
Weed wiping ........................113
Western flower thrips .............95
Wheel tracking ......................20
White Italian snail .................104
Windrowing .........................113, 114
Wrinkled seed .....................113, 114
Yellowing viruses .................26, 44
Zinceficiency .......................27, 71, 76

**Bold numbers** indicate an image
Better pulse varieties faster

Australian conditions.

growers new pulse varieties that have better disease resistance, are higher-yielding and are adapted to

by sharing germplasm, technologies and intellectual property across all states. PBA delivers to Australian

enhancement program for chickpeas, field peas, faba beans and lentils in Australia.

The establishment of Pulse Breeding Australia provides a single world-class breeding and germplasm

ensuring rapid adoption of newly released varieties.

a procient and cost effective breeding process; and

accessing elite germplasm and enabling technologies;

excelent leadership and communications;

To deliver superior pulse varieties faster, Pulse Breeding Australia (PBA) focuses on:

Pulse Breeding Australia

Lentils
Dr Michael Materne
DPI Victoria
03 5362 2312
michael.materne@dpi.vic.gov.au

Faba beans
Dr Jeff Paull
University of Adelaide
08 8303 6564
jeffrey.paull@adelaide.edu.au

FOR MORE INFORMATION

Pulse Breeding Australia
02 6166 4500
gcdc@grdc.com.au
Kingston ACT 2604
P O Box 5367,
c O GRDC
Pulse Breeding Australia