FIELD PEAS

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

Published by Primary Industries and Resources South Australia.

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2009-04-04

Designed by PIRSA Publishing

ISBN 978-1-921399-26-8

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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 Ute 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
Pea Variety Sowing Guide 2009 (SARDI)
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ABBREVIATIONS

CESAR  Centre for Environmental Stress and Adaptation Research
DAFWA  Department of Agriculture and Food, Western Australia
GRDC   Grains Research and Development Corporation
NSW DPI New South Wales Department of Primary Industries
PaDIL  Pest and Disease Image Library, Museum Victoria
QPIF   Queensland Primary Industries and Fisheries
SARDI  South Australian Research and Development Institute
VDPI   Victorian Department of Primary Industries
This guide is designed to assist in the recognition of symptoms including those of disease, insect attack and poor nutrition in field pea 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 28 of this guide. The appropriate section of the guide to seek further clarification and direction as to best practice to manage or avoid the disorder in the future is indicated.

It should be noted that varieties and products mentioned in this guide are those available and registered at February 2009, or as listed, and may change over time.

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

More erect semi-leafless variety (left), compared to a more trailing variety (right).
Major pea types (*Pisum sativum*) are based on seed coat or kernel (cotyledon) colour, size and shape. Varieties range in growth habit from trailing to erect at maturity. Trailing types can be difficult to harvest but the semi-leafless/semi-dwarf forms – with leaves modified into tendrils – can have a better standing ability, aiding harvestability. Pea varieties grown in Australia can be divided into five groups:

**Dun:** greenish-brown (dun) coloured seed with yellow cotyledons. Traditionally dimpled, but rounded types exist now. Used for human consumption and stockfeed.

**White:** cream coloured seed with yellow cotyledons and rounded seed. Large whites are used for human consumption - split and flour.

**Maple:** brown, smooth or dimpled, mottled or speckled seed with yellow cotyledons. Used for stockfeed and bird feed.

**Blue:** translucent seed coat, green cotyledons, rounded seed. Used for human consumption. Seed shape and cotyledon colour suited to specialised uses such as canning.

**Marrowfat:** very large wrinkled blue seed with green cotyledons used for canning.

Images: T Yeatman, Rural Solutions SA
Place in rotation

Field peas fit well with cereals and canola. Grass-free crops reduce cereal root diseases. Field peas should not be grown more than once within five years in the same paddock to minimise disease.

Field pea benefits to cereal rotations:
• Increase yields of following cereal crops.
• Allows an extended phase of cropping.
• Decrease many cereal diseases – grass-free pea crops break the life cycle of root diseases cereal cyst nematode and take-all.

• Control weeds – grass selective herbicides can be used on peas to control competitive grass weeds which are difficult to control in cereal crops, e.g. brome grass and barley grass.
• Can often be crop topped to prevent herbicide resistant weeds from setting seed.
• Available soil nitrogen is maintained or improved.
• Well adapted to no-till, standing stubble systems aimed at improving soil sustainability.

Be aware of herbicide residues and plant-back requirements.

Field peas usually follow a non-legume crop for disease, weed control, nutrition or risk management benefits.

Images: W Hawthorne, Pulse Australia; K Wysbeek, Burbridge Farm Ltd., Burdett, AB
Paddock selection

Field peas are grown in districts with 300–750 mm annual rainfall. They are the best adapted pulse to lower rainfall situations, but are prone to frost and heat stress during flowering and podding.

Field peas are grown successfully on a wide range of soil types, varying from sandy loams through to clays and pH_{water} 6.0–9.0. They do not tolerate waterlogging, particularly on more acidic and/or hard setting soils.

Compared to cereals, field peas provide little ground cover early in the season. Field peas are less productive on soils with a hard setting surface, or heavy clay sub-soils. Sand blasting by wind can severely damage seedling crops.

Being weak stemmed with fragile surface roots, they leave little stubble after harvest to hold the soil. If grown on erosion susceptible soils, pea stubble should either not be grazed or carefully grazed to ensure adequate stubble cover is maintained.

Growing field peas in standing cereal stubble is ideal to reduce leaf disease, conserve moisture, reduce erodability and to assist harvest.

Image: W Hawthorne, Pulse Australia
Check list for field pea paddock selection:

- Rainfall greater than 300 mm/year.
- Soil is friable, free draining, not prone to waterlogging, surface not hard setting; $\text{pH}_{\text{water}}$ between 6.0–9.0.
- Soil surface flat and free of undulations. Rolling will flatten clods, rocks and stones.
- Peas not sown in the previous four years and paddock not downwind of last year’s pea stubble to avoid blackspot.
- Few problem weeds like herbicide resistant ryegrass, medics, vetch and tares.
- Maximum herbicide plant back periods satisfied, e.g. Group Bs, clorpyralid, triazines.
- Stubble able to be sown into without leaving clumps.

Images: P Gibbs, Gibbs Agricultural Consulting; W Hawthorne, Pulse Australia

Stones need to be rolled or may limit the suitability of a paddock for field peas.

Good establishment in cereal stubble.
**VARIETY and SEED SELECTION**

### Variety

Consider markets, yield, disease reaction and maturity, along with lodging and shattering resistance.

Be aware of the necessity to segregate and market on a type and variety basis. Some varieties attract a price premium but may vary year to year.

Dun, white and blue peas are segregated from each other due to differing target markets. Duns are preferred for their taste, and Kaspa<sup>a</sup> is preferred over Parafield in India and Sri Lanka due to its round shape and lack of dimples allowing easier removal of the seed coat.

In some regions white peas are not currently accepted at sites where bulk dun segregation occurs. Consider delivery points for each type.

<table>
<thead>
<tr>
<th>Variety</th>
<th>Seed type</th>
<th>Seed size</th>
<th>Leaf form</th>
<th>Flower colour</th>
<th>Plant height</th>
<th>Flowering time</th>
<th>Maturity</th>
<th>Downy mildew Parafied strain</th>
<th>Kaspa strain&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Blackspot</th>
<th>Powdery Mildew</th>
<th>Bacterial blight pv syringae</th>
<th>Shattering</th>
<th>Lodging resistance at maturity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alma</td>
<td>Dun</td>
<td>M</td>
<td>C</td>
<td>P</td>
<td>T</td>
<td>M/L</td>
<td>L</td>
<td>S</td>
<td>-</td>
<td>S</td>
<td>S</td>
<td>-</td>
<td>MR</td>
<td>Poor</td>
</tr>
<tr>
<td>Bundi&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Wh</td>
<td>M-L</td>
<td>SL</td>
<td>W</td>
<td>M-T</td>
<td>E</td>
<td>E</td>
<td>R</td>
<td>MS</td>
<td>S</td>
<td>S</td>
<td>-</td>
<td>R</td>
<td>F-good</td>
</tr>
<tr>
<td>Dundale</td>
<td>Dun</td>
<td>M</td>
<td>C</td>
<td>P</td>
<td>T</td>
<td>E</td>
<td>M</td>
<td>S</td>
<td>-</td>
<td>S</td>
<td>S</td>
<td>-</td>
<td>MR</td>
<td>Poor</td>
</tr>
<tr>
<td>Dunwa&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Dun</td>
<td>M-L</td>
<td>C</td>
<td>P</td>
<td>T</td>
<td>M</td>
<td>M</td>
<td>S</td>
<td>-</td>
<td>S</td>
<td>S</td>
<td>MR-MS</td>
<td>MR</td>
<td>Poor</td>
</tr>
<tr>
<td>Excell</td>
<td>Blue</td>
<td>M</td>
<td>SL</td>
<td>W</td>
<td>M-T</td>
<td>E</td>
<td>E-M</td>
<td>MR</td>
<td>MS-MR</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>MS-S</td>
<td>Good</td>
</tr>
<tr>
<td>Kaspa&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Dun</td>
<td>M</td>
<td>SL</td>
<td>Pi</td>
<td>M-T</td>
<td>L</td>
<td>M</td>
<td>MR</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>R</td>
<td>F-good</td>
</tr>
<tr>
<td>Morgan&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Dun</td>
<td>S</td>
<td>SL</td>
<td>P</td>
<td>T</td>
<td>L</td>
<td>L</td>
<td>R</td>
<td>-</td>
<td>S</td>
<td>S</td>
<td>MR</td>
<td>MR</td>
<td>Poor</td>
</tr>
<tr>
<td>Parafied</td>
<td>Dun</td>
<td>M-L</td>
<td>C</td>
<td>P</td>
<td>T</td>
<td>M</td>
<td>M</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>MR-MS</td>
<td>MR</td>
<td>Poor</td>
</tr>
<tr>
<td>Sturt&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Wh</td>
<td>M-S</td>
<td>C</td>
<td>W</td>
<td>T</td>
<td>M</td>
<td>M</td>
<td>MS</td>
<td>S-MS</td>
<td>S</td>
<td>S</td>
<td>MR-MS</td>
<td>MR</td>
<td>Poor</td>
</tr>
<tr>
<td>SW Celine&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Wh</td>
<td>M-L</td>
<td>SL</td>
<td>W</td>
<td>M-T</td>
<td>E</td>
<td>E</td>
<td>MS-MR</td>
<td>-</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>MS</td>
<td>Good</td>
</tr>
<tr>
<td>Yarrum&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Dun</td>
<td>M</td>
<td>SL</td>
<td>P</td>
<td>M-S</td>
<td>L</td>
<td>M</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>R</td>
<td>MR-MS</td>
<td>MR</td>
<td>Fair</td>
</tr>
</tbody>
</table>

<sup>a</sup> based on available information

*Seed size* L= large; M= medium; S= small

*Leaf form* C= conventional; SL= semi leafless

*Flower colour* P= purple; Pi= pink; W= white

*Plant height* T= tall; M= medium; S= small

*Downy mildew, Blackspot, Powdery mildew, Bacterial blight & Shattering resistance*

S= susceptible; MS= moderately susceptible; MR= moderately resistant; R= resistant; F= Fair

*Flowering & maturity time* E= early; M= mid; L= late
Seed quality

High quality seed is vital for crop establishment.

Field pea seed is susceptible to mechanical damage during harvest. Split seed coats, fractured or broken seeds and insect damage reduce germination. Ensure seed is free of bacterial blight and has above 70% germination.

Increased hard seed can occur in dun types under certain stress conditions during seed development, resulting in low germination.

Grade seed to ensure it is free from weed and other crop seed contamination, and remove small seeds that often lack vigour.

Seed-borne diseases, blackspot, bacterial blight and *Pea seed-borne mosaic virus* (PSbMV), can reduce germination or yield. Do not keep seed from severely diseased crops. Have seed tested for disease and replace if above critical levels.

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

*Image: T Yeatman, Rural Solutions SA*
CROP ESTABLISHMENT

Field peas can be sown with machinery used for cereals. They are well suited to no-till, reduced tillage and stubble retention systems. Sow at the correct depth (3–5 cm) to ensure seed-to-soil contact for good emergence and improved safety to post-sow pre-emergent herbicides. Field peas sown between rows of standing cereal stubble are protected from wind erosion. Field peas can be successfully dry sown, if problem weeds such as medic are not an issue and a level seed surface can be achieved before herbicide application, and nodulation is assured.

Sow into a friable soil ensuring good seed to soil contact. Retain adequate plant residue on the surface to protect the soil from erosion during growth and after harvest, and to reduce soil water evaporation in early growth stages. Retained cereal stubble does not affect field pea germination or growth, and can improve establishment on hard setting, surface crusting soils. Stubble clumps cause seed placement and harvesting difficulties.

Sufficient moisture and a level soil surface must be present at application for some soil active broadleaf herbicides to be fully effective and to avoid crop damage. Leave the soil surface flat to minimise herbicide damage and assist harvest by ensuring clods or stones don’t enter the harvester.

Images: W Hawthorne, Pulse Australia

Good even establishment is the basis for a profitable crop.

Ideal seed placement in standing stubble next to last years nutritional band.
Sowing rate and plant density

Sowing rate depends on seed size, likely emergence and plant density required. Target densities tend to be lower with early sowing and higher if later sowing or on hard setting soils. Higher plant populations are required for varieties of short to medium height and lower vigour due to their lower biomass and the need for tendrils to intertwine to keep the crop upright in semi-leafless varieties. Semi-leafless varieties lose yield more rapidly in most southern Australian areas with plant densities less than 45–55 plants/sqm. Target densities tend to be lower in NSW and higher in Victoria than other areas.

<table>
<thead>
<tr>
<th>Type</th>
<th>Example variety</th>
<th>Plant density</th>
<th>Kg seed/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tall– medium height, vigorous</td>
<td>Glenroy, Morgan&lt;sup&gt;a&lt;/sup&gt;, Parafild, Sturt&lt;sup&gt;a&lt;/sup&gt;</td>
<td>30–45</td>
<td>80–120</td>
</tr>
<tr>
<td>Medium–tall height, semi leafless</td>
<td>Kaspa&lt;sup&gt;b&lt;/sup&gt;</td>
<td>40–60</td>
<td>85–130</td>
</tr>
<tr>
<td></td>
<td></td>
<td>35–50*</td>
<td>75–110*</td>
</tr>
<tr>
<td>Medium height, less vigour</td>
<td>Excell, Bundi&lt;sup&gt;b&lt;/sup&gt;; SW Celine&lt;sup&gt;b&lt;/sup&gt;, Yarrum&lt;sup&gt;b&lt;/sup&gt;</td>
<td>40–60</td>
<td>110–165</td>
</tr>
<tr>
<td></td>
<td></td>
<td>40–80#</td>
<td>110–220#</td>
</tr>
<tr>
<td>Short–medium height, lower vigour</td>
<td>Mukta, Soupa, Paravic</td>
<td>65</td>
<td>150–180</td>
</tr>
</tbody>
</table>

* rate for NSW;  # rate for Victoria.

Achieving a target plant density depends on a seeding rate to match the seed size.

Use the formula:

\[
\text{Seeding rate (kg/ha)} = \frac{\text{Plant density (plants/m}^2\text{)} \times 1000 \text{ seed wt (g)}}{\text{Emergence percentage}}
\]

<sup>†</sup>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.

*Image: W Hawthorne, Pulse Australia*
Time of sowing

Time of sowing is a compromise between avoiding increased disease and frost risk from earlier sowing, and yield loss from later sowing due to high temperatures and/or dry conditions at flowering and pod fill. Sow at the later end of the recommended optimum for the district where disease and frost risks are high. Peas can be sown dry.

• Delay sowing to manage the risk of blackspot – where high intensity of pea stubbles and, where no summer rain and sowing soon after the opening rain. (See Blackspot manager p45)
• Early sowing increases exposure of seedlings to a greater number of blackspot spores, over a longer period. It also results in more vegetative growth and in longer growing season areas increased lodging can lead to an increased risk of leaf disease.
• In areas where blackspot is a moderate or high risk delay sowing so emergence is four weeks later than the first rain to allow release of blackspot spores from pea stubble. Earlier sowing may be possible if significant summer-autumn rains have fallen. In warmer areas like the central, eastern and northern wheat-belt of WA, summer rains may not give the spore release seen in the cooler southern areas of WA and the eastern states.

Images: W Hawthorne, Pulse Australia

Early sown crop (left) is less susceptible to heat at flowering or a dry spring, but is more susceptible to Blackspot and frost.
## Optimum sowing times for southern Australia

<table>
<thead>
<tr>
<th>Region (annual rainfall)</th>
<th>Month</th>
<th>May</th>
<th>June</th>
<th>July</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Week</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Less than 350 mm – northern agricultural region – WA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 350 mm – central and southern agricultural areas – WA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Greater than 350 mm – WA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 400 mm – SA/Vic</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>400–450 mm – SA/Vic</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>450–500 mm – SA/Vic</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>500–600 mm* – SA/Vic</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 450 mm – southern NSW</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>450–550 mm – southern NSW</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>500–650 mm* – southern NSW</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**

# Use Blackspot Manager (see p45) to determine Blackspot risk with particular sowing dates each year. Sow later if Blackspot is a threat following a late break, or if frost is a risk.

*Preferred sowing time for spring sown field peas in south eastern Australia is August - September.*
Sowing depth

Sow at a depth of between 3–8 cm. Adjust sowing depth based on the soil type and texture, and take into account depth of soil covering the seed.

On friable clays, loams and lighter soils, sow deeper (>5 cm), but on hard setting soils sow shallower (near 3 cm) to ensure establishment.

On some well structured, lighter soils it may be possible to sow deeper than normal if seeking sub-soil moisture to maximize germination. Rolling or harrowing after sowing or wind erosion can lead to an increased depth for seedlings to emerge.

Post-sowing herbicides can wash into seed rows from ridges if left unflattened after seeding (see p22).

Wheel tracking

Row placement can be important. Consider ‘tramlining’ and ‘controlled traffic’. Physical damage to the crop from machinery travelling over the paddock can be a cause of disease or poor grain quality.
Row spacing

Row spacing can be varied (15–45 cm), but the wider rows are only used if sowing is into standing cereal stubble to minimise lodging at harvest. Some growers use medium-wide row spacing (25–36 cm) to suit trash clearance, intra-row weed control or to allow more air movement between the rows in the belief that blackspot disease risk is reduced.

The height to bottom pods is often increased with wider row spacing or with higher seeding rates. Weed control can be more difficult with wider row spacing unless shielded sprayers are used.

*Images:* W Hawthorne, T Bray, Pulse Australia

Row spacing in peas crops is generally nearer 18cm to enhance competition with weeds and improve ease of harvest.

Twin rows of peas.

Exposure of ground to moisture loss and weed growth with wider rows minimised by presence of stubble.
Inoculation

Group E inoculum is preferred for field peas, but Group F may also be used to ensure plants are well nodulated to supply ‘fixed’ nitrogen and do not rely on available soil nitrogen.

If soil rhizobia levels are low, inoculation of the seed (or the soil) with Group E rhizobium can provide large increases in growth, yield and residual soil nitrogen. There is the need to maximise nodulation and nitrogen fixation. Effective nodulation may occur on soils where inoculated field pea, faba bean, lentil or vetch has grown previously.

Regular inoculation with Group E rhizobia may be necessary on waterlogged and acidic soils, particularly poorly structured red clays or red brown earths where conditions for survival of rhizobia are poor. Group E rhizobia survive well in neutral to alkaline loams or clays.

Granular and other forms of inoculum now available may assist rhizobial survival, particularly in acid soils or when the peas are sown dry.
Fungicide seed treatment

Fungicidal seed dressing is part of an overall disease management strategy protecting against certain root and leaf diseases. It can also improve seed emergence, especially in wet winters. Downy mildew is best controlled by metalaxyl seed treatment which will also provide protection from some other root rots such as *Pythium*. Thiram and thiabendazole fungicidal seed treatment can control seedborne spores of blackspot and some root rots up to 8–10 weeks after sowing and may improve yield. This is more likely to be economic in higher risk situations such as early sowing.

If using both inoculum and seed dressing, apply the seed dressing first and then inoculate immediately before seeding. Do not mix inoculants and seed dressings together unless the inoculant’s label specifies compatibility.

*See page 33 for seed treatments.*
Avoiding herbicide damage

Under adverse conditions, most post sowing, pre-emergent (PSPE) herbicides are capable of causing crop damage. Post-emergent applications can cause damage in some circumstances. In most cases damage can be attributed to the products solubility and:

- Sowing too shallow.
- Applying the herbicides to dry soils followed by heavy rainfall.
- Rate too high for the soil type.
- Uneven soil surface.
- Herbicide washing into press wheel furrows.
- Differences in susceptibility of varieties.

To reduce the risks of herbicide damage when using herbicide PSPE on peas:

- Sow at 5 cm or deeper.
- Apply the herbicides to a level soil surface (e.g. prickle chaining, harrowing).
- Consider incorporating herbicide by seeding (IBS) or split application.
- Rolling after press wheels may not do enough to level out the furrow on heavier soils. Harrowing prior to rolling will leave a flatter surface.
- Avoid applying these herbicides post sowing to dry soils and in front of a heavy rain.
- Choose the right rate for your soil type (lighter soils require lower rates).

Image: T Yeatman, Rural Solutions SA
Rolling

Surface rolling or prickle chaining flattens clods and ridges caused by sowing or press wheels. Rolling also presses rocks and sticks into the soil leaving a flat surface to allow easier harvest. This reduces harvest losses, harvester wear and contamination in the seed sample. Sowing with modern disc machines or with lodging resistant varieties may eliminate the need to roll peas. Beneficial trellising effects of standing cereal stubble may be lost or reduced by rolling.

Rolling is often done post-sowing pre-emergence. A rubber-type roller is best, used when the soil is moist but not too wet or dry. If rolling post-emergence, it is best done at the 3–5 node stage under warm conditions when plants are limp and well established. Avoid rolling when plants are just emerging as the young shoots can be damaged. Choose an afternoon on a warmer day to minimise crop damage.

Avoid rolling two weeks before or after applying a post-emergent herbicide. Do not roll peas post-emergence in areas prone to bacterial blight. Delay rolling until the crop has emerged if the soil is prone to hard setting or crusting or prone to erosion on sandy or sloping ground.

Clods left in paddocks can make harvesting difficult.

Rolling is best done pre-emergence, but at the 3–5 node stage if post-emergence once plants are well established.

Post-emergent rolling can increase susceptibility to leaf diseases and affect flowering.

Images: W Hawthorne, Pulse Australia; I Pritchard, DAFWA
Field pea (*Pisum sativum*) – conventional leaf type
e.g. Dundale, Parafield, Alma.

Field Pea herbicide labels refer to the number of nodes for the timing of herbicide applications.


Nodes are counted from the point at which the first true leaves are attached to the stem.
Field pea (*Pisum sativum*) – semi-leafless type
e.g. Kaspa, Excell, Snowpeak, Mukta, Morgan, Yarrum.

Field Pea herbicide labels refer to the number of nodes for the timing of herbicide applications.


Nodes are counted from the point at which the first true leaves are attached to the stem.
### Pea growth stage scale*

<table>
<thead>
<tr>
<th>Development phase</th>
<th>Growth stage (GS)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>00 Germination</td>
<td>GS 000 Dry seed</td>
<td></td>
</tr>
<tr>
<td></td>
<td>GS 001 Imbibed seed</td>
<td></td>
</tr>
<tr>
<td></td>
<td>GS 002 Radicle apparent</td>
<td></td>
</tr>
<tr>
<td></td>
<td>GS 003 Plumule and radicle apparent</td>
<td></td>
</tr>
<tr>
<td></td>
<td>GS 004 Emergence</td>
<td></td>
</tr>
<tr>
<td>10 Vegetative</td>
<td>GS 101 First node</td>
<td>First leaf fully unfolded with one pair leaflets</td>
</tr>
<tr>
<td></td>
<td>GS 10(X) X node</td>
<td>X leaf fully unfolded with more than one pair of leaflets, complex tendril</td>
</tr>
<tr>
<td></td>
<td>GS1(N) N, Last recorded node</td>
<td>N – any number of nodes on the main stem with fully unfolded leaves</td>
</tr>
<tr>
<td></td>
<td></td>
<td>according to cultivar</td>
</tr>
<tr>
<td>20 Reproductive</td>
<td>GS 201 Enclosed buds</td>
<td>Small flower buds enclosed in terminal shoot</td>
</tr>
<tr>
<td></td>
<td>GS 202 Visible buds</td>
<td>Flower buds visible outside terminal shoot</td>
</tr>
<tr>
<td></td>
<td>GS 203 First open flower</td>
<td></td>
</tr>
<tr>
<td></td>
<td>GS 204 Pod set</td>
<td>A small immature pod</td>
</tr>
<tr>
<td></td>
<td>GS 205 Flat pod</td>
<td></td>
</tr>
<tr>
<td></td>
<td>GS 206 Pod swell</td>
<td>Pods swollen but still with small immature seeds</td>
</tr>
<tr>
<td></td>
<td>GS 207 Pod fill</td>
<td>Green seeds fill the pod cavity</td>
</tr>
<tr>
<td></td>
<td>GS 208 green wrinkled pod</td>
<td></td>
</tr>
<tr>
<td></td>
<td>GS 209 Yellow wrinkled pod</td>
<td>Seed rubbery</td>
</tr>
<tr>
<td></td>
<td>GS 210 Dry seed</td>
<td>Pods dry and brown, seed dry and hard</td>
</tr>
<tr>
<td>30 Senescence</td>
<td>GS 301 lower pods dry and brown, seed dry, middle pods yellow and wrinkled,</td>
<td>Seed rubbery, upper pods green and wrinkled, desiccant application stage</td>
</tr>
<tr>
<td></td>
<td>seed rubbery, upper pods green and wrinkled, desiccant application stage</td>
<td></td>
</tr>
<tr>
<td></td>
<td>GS 302 lower and middle pods dry and brown, seed dry, upper pods yellow and</td>
<td></td>
</tr>
<tr>
<td></td>
<td>wrinkled, seed rubbery, pre-harvest stage</td>
<td></td>
</tr>
<tr>
<td></td>
<td>GS 303 all pods dry and brown, seed dry, dry harvest stage</td>
<td></td>
</tr>
</tbody>
</table>

*Source: A.J Biddle and C.M Knott, 1998*
DID YOU KNOW

- It is estimated that introduced invertebrate pests cost Australian agriculture more than $4.7 billion in lost production annually and

- A further $750 million is spent on control costs.

Do you know what pest is damaging your crop or how to manage it?

For options on managing pests in your grain crops go to:

<table>
<thead>
<tr>
<th>Crop affect</th>
<th>Distribution</th>
<th>Plant symptoms</th>
<th>Disorder</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor emergence</td>
<td>Patches</td>
<td>Seed rotted</td>
<td>Damping off</td>
<td>45</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Plants chewed</td>
<td>Mice</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Snails</td>
<td>110</td>
</tr>
<tr>
<td>General</td>
<td>Patches</td>
<td>Plants distorted</td>
<td>Trifluralin damage</td>
<td>58</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Plants stunted</td>
<td>Seed sown too deep</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ungemerminated seed</td>
<td>Poor storage</td>
<td>131</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Insect damage</td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>Wilting</td>
<td>Scattered plants</td>
<td>Reduced growth – yellow</td>
<td>Fusarium wilt</td>
<td>48</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yellow/red</td>
<td>Virus</td>
<td>36</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Premature death</td>
<td>Root rots</td>
<td>45, 48</td>
</tr>
<tr>
<td></td>
<td>Patches</td>
<td>Stunted</td>
<td>Herbicide damage</td>
<td>53</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Premature death</td>
<td>Fusarium wilt</td>
<td>48</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Water logging</td>
<td>82</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Virus</td>
<td>34</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Salinity</td>
<td>114</td>
</tr>
<tr>
<td></td>
<td>General</td>
<td>Plants limp</td>
<td>Herbicide damage</td>
<td>55</td>
</tr>
<tr>
<td>Stunted/distorted</td>
<td>Scattered</td>
<td>Reduced growth</td>
<td>Orobanche (Broom Rape)</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Leaves/stem distorted</td>
<td>Stem nematode</td>
<td>51</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Virus</td>
<td>36</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Downy mildew</td>
<td>46</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Mites</td>
<td>95</td>
</tr>
<tr>
<td></td>
<td>Patches</td>
<td>Yellow – death of young leaves</td>
<td>Iron deficiency</td>
<td>74</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Manganese deficiency</td>
<td>75</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Sulfonyle urea damage</td>
<td>54</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Broadstrike® damage</td>
<td>54</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yellow/red</td>
<td>Damping off (pythium root rot)</td>
<td>45</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Virus</td>
<td>36</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Nodulation failure</td>
<td>77</td>
</tr>
<tr>
<td></td>
<td>General</td>
<td></td>
<td>Herbicide damage (eg. Hormone)</td>
<td>62</td>
</tr>
<tr>
<td>Crop affect</td>
<td>Distribution</td>
<td>Plant symptoms</td>
<td>Disorder</td>
<td>Page</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>------------------</td>
<td>-----------------------------------------------</td>
<td>---------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>Leaf and stem spotting/</td>
<td>Scattered plants</td>
<td>Brown</td>
<td>Bacterial blight</td>
<td>40</td>
</tr>
<tr>
<td>discolouration</td>
<td></td>
<td>Purplish black spots</td>
<td>Blackspot</td>
<td>42</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yellow leaves</td>
<td>Virus</td>
<td>36</td>
</tr>
<tr>
<td>General</td>
<td></td>
<td>Cream to white blotches</td>
<td>Diflufenican damage</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yellow /red</td>
<td>Septoria</td>
<td>49</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tip death</td>
<td>Triazine damage</td>
<td>56</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Iron and zinc deficiency</td>
<td>74, 76</td>
</tr>
<tr>
<td>Leaves</td>
<td></td>
<td>Yellow between veins</td>
<td>Manganese deficiency</td>
<td>75</td>
</tr>
<tr>
<td>Pods discoloured</td>
<td>General</td>
<td>Shrunken – purplish-brown</td>
<td>Blackspot</td>
<td>44</td>
</tr>
<tr>
<td>Fungal growth</td>
<td>Stems and leaves</td>
<td>Grey on underside of leaves</td>
<td>Downy mildew</td>
<td>46</td>
</tr>
<tr>
<td></td>
<td></td>
<td>White on upper side of leaves</td>
<td>Powdery mildew</td>
<td>47</td>
</tr>
<tr>
<td></td>
<td></td>
<td>May be with a soft slimy rot, may have larger black sclerotes</td>
<td>Sclerotinia</td>
<td>50</td>
</tr>
<tr>
<td>Physical damage</td>
<td>Patches</td>
<td>Plants chewed</td>
<td>Mouse damage</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Snail damage</td>
<td>110</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pods chewed</td>
<td>Native budworm</td>
<td>92</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Lucerne seed web moth</td>
<td>90</td>
</tr>
<tr>
<td></td>
<td>General</td>
<td>Stem, leaves and pods damaged</td>
<td>Mouse damage</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Hail damage</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Stem bent and twisted</td>
<td>Frost</td>
<td>78</td>
</tr>
</tbody>
</table>
Effective disease management relies on the combined use of the correct selection of the variety with the best profile of disease resistance, the most suitable paddock, clean seed, agronomic practices and canopy management, as well as the use of fungicides.

<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 pea crops.</td>
</tr>
<tr>
<td>Paddock hygiene</td>
<td>Select paddocks at least 500 m from last year’s pea crop stubble if affected with blackspot.</td>
</tr>
<tr>
<td>Variety</td>
<td>Select a variety with suitable disease resistance for your district.</td>
</tr>
<tr>
<td>Seed source</td>
<td>Use seed from disease free crops, or with known freedom from bacterial blight, viruses and less than 5% blackspot seed infection – laboratory seed tests are useful.</td>
</tr>
<tr>
<td>Sowing time</td>
<td>Do not sow too early. Sow within the optimum sowing window for your district after a decline in blackspot spore showers.</td>
</tr>
<tr>
<td>Sowing rate</td>
<td>Higher seeding rates than the recommended plant population for the district increases the risk of disease due to denser canopy growth.</td>
</tr>
<tr>
<td>Row spacing</td>
<td>Wider row spacing does not reduce disease incidence in peas.</td>
</tr>
<tr>
<td>Fungicide application</td>
<td><strong>Seed:</strong> Thiram + thiabendazole will reduce disease transmission by seed and help control blackspot and seedling root rots. Metalaxyl will control downy mildew and damping off (<em>Pythium</em>).</td>
</tr>
<tr>
<td></td>
<td><strong>Foliar:</strong> Foliar fungicide can effectively control powdery mildew. A foliar fungicide program for controlling blackspot and <em>Septoria</em> in peas requires several applications.</td>
</tr>
<tr>
<td>Aphid control</td>
<td>Cultural practices like summer weed control, crop density, stubble presence and minimising bare soil reduces aphid numbers. Aphicides are generally applied too late to stop the spread of aphid-borne viruses. Control may be beneficial if aphids are detected early.</td>
</tr>
<tr>
<td>Mechanical damage</td>
<td>Traffic, wind erosion, frost, hail or herbicide damage can all lead to the spread of bacterial blight within an infected paddock.</td>
</tr>
<tr>
<td>Harvest management</td>
<td>Early harvest can help minimise disease infection of seed, important for grain quality and to minimise harvest losses. Crop desiccation enables even earlier harvest. Receival standards now allow higher moisture content (14%).</td>
</tr>
</tbody>
</table>
Relative importance of various sources of infection for key field pea diseases

<table>
<thead>
<tr>
<th>Disease</th>
<th>Stubble</th>
<th>Seed</th>
<th>Soil</th>
<th>Aphids</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blackspot</td>
<td>***</td>
<td>*</td>
<td>*</td>
<td>-</td>
</tr>
<tr>
<td>Bacterial blight#</td>
<td>**</td>
<td>***</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Septoria</td>
<td>***</td>
<td>**</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Foot rot</td>
<td>**</td>
<td>*</td>
<td>***</td>
<td>-</td>
</tr>
<tr>
<td>Downy mildew</td>
<td>**</td>
<td>*</td>
<td>***</td>
<td>-</td>
</tr>
<tr>
<td>Powdery mildew</td>
<td>*</td>
<td>*</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Seedborne viruses</td>
<td>-</td>
<td>***</td>
<td>-</td>
<td>***</td>
</tr>
<tr>
<td>Non-seedborne viruses</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>***</td>
</tr>
</tbody>
</table>

Relative importance

- Nil
* Minor
** Moderate
*** Major

# Some broadleaf weeds can carry over disease.

Ref: Grain Legume Handbook

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 a significant risk before crops are sown. The tests relevant to peas measure soil inoculum levels of rhizoctonia bare patch, stem nematode and blackspot. The blackspot test is best used in conjunction with the ‘Blackspot Manager’ model (see p43).

Images: W Hawthorne, Pulse Australia; P Baker, formerly Rural Directions
# Pea diseases and potential for cross infection from other pulses

<table>
<thead>
<tr>
<th>Disease</th>
<th>Field peas</th>
<th>Lentils</th>
<th>Faba beans</th>
<th>Vetch</th>
<th>Chickpeas</th>
<th>Lupins</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Botrytis grey mould</strong></td>
<td>*</td>
<td>**</td>
<td>*</td>
<td>**</td>
<td>**</td>
<td>*</td>
</tr>
<tr>
<td><em>Botrytis cinerea</em></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Bacterial blight</strong></td>
<td>**</td>
<td>*</td>
<td>**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Pseudomonas syringae pv. syringae</em></td>
<td>**</td>
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<td></td>
</tr>
<tr>
<td><em>P syringae pv pisi</em></td>
<td>**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Blackspot</strong></td>
<td>**</td>
<td>**</td>
<td></td>
<td></td>
<td></td>
<td>*</td>
</tr>
<tr>
<td><em>Mycosphaerella pinodes</em></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td><strong>Phoma koolunga</strong></td>
<td>**</td>
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<td>*</td>
</tr>
<tr>
<td><em>Phoma medicaginis var pinodella</em></td>
<td>**</td>
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</tr>
<tr>
<td><strong>Downy mildew</strong></td>
<td>**</td>
<td>**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Peronospora viciae</em></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td><strong>Powdery mildew</strong></td>
<td>**</td>
<td>**</td>
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<td></td>
<td></td>
</tr>
<tr>
<td><em>Erysiphe pisi</em></td>
<td></td>
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</tr>
<tr>
<td><strong>Root Rots</strong></td>
<td>*</td>
<td>*</td>
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<td>*</td>
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<td>*</td>
</tr>
<tr>
<td><em>Fusarium sp.</em></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td><em>Pythium sp.</em></td>
<td>*</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td><strong>Rhizoctonia sp.</strong></td>
<td>**</td>
<td>**</td>
<td>**</td>
<td></td>
<td></td>
<td>**</td>
</tr>
<tr>
<td><strong>Septoria</strong></td>
<td>**</td>
<td>**</td>
<td></td>
<td></td>
<td></td>
<td>**</td>
</tr>
<tr>
<td><em>Septoria pisi</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Sclerotinia</strong></td>
<td>*</td>
<td>*</td>
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</tr>
<tr>
<td><em>spp.</em></td>
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<td></td>
<td></td>
</tr>
<tr>
<td><strong>Stem nematode</strong></td>
<td>**</td>
<td>**</td>
<td></td>
<td></td>
<td></td>
<td>*</td>
</tr>
<tr>
<td><em>Ditylenchus dipsaci</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Virus</strong></td>
<td>**</td>
<td>**</td>
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<td></td>
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</tr>
<tr>
<td><em>Non-seedborne (e.g. BLRV)</em></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td><em>Seedborne (e.g. PSbMV)</em></td>
<td>**</td>
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<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.

Pythium and Botrytis Grey Mould is worse (**) in white peas than in Duns (*). Ref: Grain Legume Handbook.
# Fungicide guide

<table>
<thead>
<tr>
<th>Chemical+</th>
<th>Seed treatment</th>
<th>Foliar fungicide</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thiram + thiabendazole</td>
<td>Metalaxyl-M #</td>
<td>Metalaxyl #</td>
</tr>
<tr>
<td>Products (February 2009)</td>
<td>P-Pickel T® Fairgro® Reaper®TT</td>
<td>Apron XL®</td>
</tr>
</tbody>
</table>

| Representative products of many for most chemicals |

| WHP Grazing | N/r | N/r | N/r | 14 days | No grazing | - | - | 3 days |
| Harvest | N/r | N/r | N/r | 28 days | 7 days | 1 day | 14 days | 3 days |

## Disease

<table>
<thead>
<tr>
<th>Seeding</th>
<th>Foliar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blackspot</td>
<td>✓*</td>
</tr>
<tr>
<td>Downy mildew</td>
<td>-</td>
</tr>
<tr>
<td>Powdery mildew</td>
<td>-</td>
</tr>
<tr>
<td>Seedling root rot</td>
<td>✓*</td>
</tr>
<tr>
<td>Damping off</td>
<td>✓*</td>
</tr>
<tr>
<td>Bacterial blight</td>
<td>-</td>
</tr>
</tbody>
</table>

✓ Disease controlled or suppressed
- 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; N/r – Not required

Go to PUBCRIS APVMA, [www.apvma.gov.au](http://www.apvma.gov.au), for full list of registered products. # Check label for State product registration.
**Fungicide spraying program**

There are four critical periods for fungicide application to pea crops for disease:

1. Seed treatment to protect pea seedlings for 6–8 weeks.
2. Vegetative (from 9 node stage), prior to flower formation.
3. Early flowering, prior to seed fill.
4. Mid flowering, mid pod fill.

**Fungicide application guide by crop stage, disease and risk category**

<table>
<thead>
<tr>
<th>Crop Stage</th>
<th>Disease</th>
<th>Higher risk situation</th>
<th>Fungicide treatment to consider</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seeding</td>
<td>Blackspot</td>
<td>Pea stubble close proximity</td>
<td>If high – medium risk, seed treat with: thiamendazole + thiram</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Soil borne risk due to tight pea rotation</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Early sowing</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Absence of summer rainfall</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Higher rainfall region/long growing season</td>
<td></td>
</tr>
<tr>
<td>Early sowing</td>
<td>Absence of summer rainfall</td>
<td>If high – medium risk, seed treat with: thiamendazole + thiram</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Historical presence of the disease</td>
<td>If high-risk, seed treat with: metalaxyl</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Regular pea cropping history</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Susceptible variety grown</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cold, wet conditions in winter</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Downy mildew</td>
<td>Historical presence of the disease</td>
<td>If high-risk, seed treat with: metalaxyl</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Regular pea cropping history</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Susceptible variety grown</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cold, wet conditions in winter</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Common root rots</td>
<td>Recent history of clover/medic pasture</td>
<td>If high risk, seed treat with: thiamendazole + thiram or thiram</td>
<td></td>
</tr>
<tr>
<td></td>
<td>History of root rot</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Damping off</td>
<td>Clover/medic pasture history</td>
<td>If high risk, seed treat with: metalaxyl, metalaxyl-M, thiamendazole + thiram, or thiram</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Water logged soils</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Early vegetative to 9 node</td>
<td>Blackspot</td>
<td>Early sowing</td>
<td>If high risk, consider applying foliar fungicide at 8–10 nodes in advance of rainfall to minimise spread in next 2–3 weeks: mancozeb or chlorothalonil</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No seed treatment used</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Regular rainfall events in season</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Blackspot has infected crop</td>
<td></td>
</tr>
<tr>
<td>Stage</td>
<td>Disease</td>
<td>Symptoms</td>
<td>Recommended Treatment</td>
</tr>
<tr>
<td>-----------------------</td>
<td>------------------</td>
<td>--------------------------------------------------------------------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>Early vegetative to 9 node</td>
<td>Downy mildew</td>
<td>Historical presence, Susceptible variety grown, Disease present, No seed treatment used, Prolonged cold weather</td>
<td>None registered</td>
</tr>
<tr>
<td></td>
<td>Septoria</td>
<td>Regular history of field peas, History of septoria disease in paddock, Warm wet conditions</td>
<td>None registered</td>
</tr>
<tr>
<td>Pre-Flowering</td>
<td>Blackspot</td>
<td>Higher risk paddock, Disease present, Regular rainfall events</td>
<td>If high risk and disease controlled until this stage, apply foliar fungicide in advance of rainfall event to minimise further infection in next 2–3 weeks: mancozeb, or chlorothalonil</td>
</tr>
<tr>
<td></td>
<td>Downy mildew</td>
<td>Disease present</td>
<td>None registered</td>
</tr>
<tr>
<td></td>
<td>Septoria</td>
<td>Disease present</td>
<td>None registered</td>
</tr>
<tr>
<td>Flowering-Pod fill</td>
<td>Blackspot</td>
<td>Disease present, Regular rainfall events</td>
<td>None effective (too late)</td>
</tr>
<tr>
<td></td>
<td>Downy mildew</td>
<td>Disease present</td>
<td>None effective (too late)</td>
</tr>
<tr>
<td></td>
<td>Powdery mildew</td>
<td>Susceptible variety, Disease regularly occurs in region, Humid conditions in spring, Crop &gt; 4 weeks until ripe, Spring rainfall and &gt;20º C</td>
<td>As soon as powdery mildew is detected and it is a high risk situation: tebuconazole or triadimefon</td>
</tr>
</tbody>
</table>
Controlling viruses

Field pea crops can be affected by a number of virus diseases. Some are seed borne, but all require aphids to move between plants. Most require a ‘green bridge’ to survive between seasons.

PSbMV, AMV, BYMV, CMV and CYVV are non-persistent in aphids. The aphids soon lose infection after feeding on infected plants, spreading virus only over short distances.

BLRV, BWYV, SbDV and SCSV (yellowing or luteo-viruses), are persistent in aphids. The aphid remains infected for life and can spread the virus over a long time and distance. Spread of the virus can be controlled through aphicide applications.

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.

1. Seed-borne viruses can be controlled by sowing clean seed. Sow 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. Manage the crop to 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.

Pea seed-borne mosaic virus (PSbMV)

Description
The only seed borne virus of importance in field peas in Australia. Plant symptoms are usually very mild and difficult to detect. Plants are stunted and mature later than uninfected plants.

Margins of young leaves are rolled downward, there is mild chlorosis, mosaic, veins are clear. Terminal leaves are often reduced in size and tendrils excessively curled. Infection at later stages results in top leaves turning yellow.

Pods develop poorly and seed is shrunken with brown staining and a blistered surface.

Seed may exhibit surface with tennis ball markings.

Very high levels (> 30%) of seed transmission can occur in susceptible varieties like Kaspa and Excell.

Management
Sow varieties with resistance e.g. Yarrum. Sow disease free seed. Sow dense crops or avoid bare ground with stubble cover.

Isolate field pea crops from other pulse crops.

Control aphids early to prevent establishment in crops.

Do not grow in close rotation with, or close to, faba bean, chickpea, lathyrus or vetch.

Images: M. Ramsey, formerly SARDI
**Bean leafroll virus (BLRV), Bean western yellows virus (BWyV), Soybean dwarf virus (SbDV) and Subterranean clover stunt virus (SCSV)**

**Description**
Infected seedlings are uniformly yellow or red, stunted and die prematurely. With later infection the top leaves turn yellow first, before affecting the whole plant.

Not seedborne.

BLRV is the most important virus in northern field pea areas.

**Management**
Grow varieties with lower susceptibility e.g. Yarrum (BLRV).

Prevent the buildup of aphid numbers.

Sow dense crops or avoid bare ground through stubble cover.

*Images: M Schwinghamer, NSW DPI*
Bean yellow mosaic virus (BYMV), Clover yellow vein virus (CYVV), Alfalfa mosaic virus (AMV), Cucumber mosaic virus (CMV)

Description
These viruses are generally of minor economic importance. They can be seed borne at low levels.

Symptoms can include mosaic, mottling and yellowing.

(Left and below) Pea plant infected with CYVV late, showing yellowing and death of growing tips.

(Left) Pea plant infected with BYMV causing mottling of leaves and clearance of veins.

Images: M Ramsey, formerly SARDI
Bacterial blight  \textit{(Pseudomonas syringae pv. pisi and P. syringae pv. syringae)}

\textbf{Description}

Plants can be affected at all growth stages.

Water-soaked olive-green to dark brown spots develop on the base of stems turning yellowish, then brown and papery; lesions are limited by veins. Spots can merge causing the stem to shrivel and die.

Stem infection can spread along the veins producing fan-shaped lesions in stipules; affected veins become brown-black.

Lesions on pods are sunken and olive brown.

Worst where sown into mulched cereal stubbles.

Infection less where there is bare ground.

\textbf{Management}

Grow a more resistant variety (e.g. Parafield, Yarrum\textsuperscript{b}).

Sow clean uninfected seed.

Preferably sow into standing cereal stubble.

Early sown crops are more vulnerable in wet seasons.

\textbf{Image:} M Ramsay, formerly SARDI
Avoid sowing into or near infected pea trash.

Avoid frosty areas, physical damage (hail, strong wind, sand blasting, wheel tracks etc.) and herbicide injury which predispose plants to infection.

Do not apply post-emergent herbicides in frosty conditions.

Water soaked dark green spots on leaves.

Olive brown lesions on pods.

Images: J Wilson, Elders; P Baker, Rural Directions
**Blackspot** (*Mycosphaerella pinodes, Phoma koolunga, Phoma medicaginis var pinodella and Ascochyta pisi*)

**Description**
Lower stems are stained and streaked purplish-black.

Leaf spots initially begin as numerous, small purple/dark brown spots or a few large circular brown spots, which merge into large areas and may kill the entire leaf.

Spots common on pods, often merging to form large, sunken, purplish-black areas.

Severely infected seeds have spots or purplish-brown stains, but lightly infected seeds appear normal.

Disease increased by crop stress e.g. waterlogging, herbicide application.

Severe cases – stem infection can lead to stem or foot rot, which can kill the plant (phoma root rot).

**Management**
Avoid sowing peas close in the rotation (i.e. three years or less) and avoid sowing peas within 500 m of pea stubble paddocks.

Use PreDicta™-B to assess soilborne levels of disease (available from SARDI). This is not used in WA for blackspot.

Delay sowing until spore showers have abated, guided by Blackspot Manager (see below).

Avoid waterlogging which increases blackspot and collar rot.

Use seed dressing and strategic foliar fungicide where risk high.

*Image:* W Hawthorne, Pulse Australia
**Blackspot Manager**

www.agric.wa.gov.au/cropdiseases

A model that assists growers in WA, SA and soon Victoria to predict the risk of blackspot disease. It calculates the timing of spore release using seasonal rainfall and temperature data, and indicates if a delay in sowing is necessary to minimise the risk of blackspot.

Take rainfall region into account, but:

- Sowing peas early is possible when ‘Blackspot Manager’ indicates the risk of airborne spores is low.
- Delayed sowing is suggested when ‘Blackspot Manager’ indicates the risk of airborne spores is high.

The risk of airborne spore inoculum indicated by the ‘Blackspot Manager’ model is additional to the soilborne risk measured by PreDicta™-B soil tests.
Grey mould (*Botrytis cinerea*)

**Description**
Develops first on dead tissue, particularly old flowers and then spreads to other plant parts; under moist conditions.

Leaves, flowers and stem become covered with fluffy blue-grey mould and die.

Stem, leaf and pod rot occurs under humid conditions.

Seed infection can affect crop establishment. There are other sources of infection and disease development depends on environmental conditions.

**Management**
White seeded varieties are more susceptible, but it can also attack other varieties.

Avoid high seeding rates leading to dense crops, particularly where high rainfall.

Sow disease free seed. Seed infection levels below 5% are unlikely to significantly increase the risk of disease outbreak.

Wider than normal row spacing may help eliminate dense canopies which are more conducive to botrytis grey mould.

*Image: M Ramsay, formerly SARDI*
Damping off (*Pythium* spp.)

**Description**
Plants are affected very early (often dying before emergence).
Survivors are stunted and yellow; plants may partially recover, but lack vigour and yield poorly.
Seeds rot rapidly, with a slimy tan coloured appearance.
Poor lateral root growth.
Poorly developed root system (root hairs rotted), tan to light brown with watery-soft rotted texture.

**Management**
Avoid very wet soils; heavy rains immediately after sowing; deep seeding; and hard-setting soils.
White seeded varieties are more susceptible.
A seed treatment of metalaxyl may be beneficial.

Images: T Bretag, formerly VDPI
Downy mildew (*Peronospora viciae*)

**Description**

Occurs in wet, cool seasons.

Usually a seedling disease in winter but may continue onto adult plants.

Develops on the underside of leaves with a fluffy, mouse-grey spore mass.

Occurs on lower leaves first, then progresses up the plant, sometimes infecting the flowers and pods.

May infect plants systemically; plants become pale yellowish-green, stunted and distorted.

Local leaf lesions occur as isolated pale yellow-brown blotches on the upper leaf surface with grey spore mass underneath.

Infected pods are deformed and covered with yellow to brownish patches and surface blisters.

**Management**

Avoid sowing into paddocks with a history of downy mildew or into pea trash.

Sow disease free seed.

Treat seed with fungicide (metalaxyl).

Use a resistant variety, but appreciate new strains can develop.

Images: M Ramsay, formerly SARDI; W Hawthorne, Pulse Australia

Seedling pale yellowish-green, stunted and distorted

(Top and above) Mouse-grey fluffy spore mass on stem and leaves
Powdery mildew (*Erysiphe pisi*)

**Description**
Occurs when rain in late spring followed by warm days and cool nights.

White fungal growth on upper leaf surface, initially circular but spreads rapidly.

Leaves, stems and pods of plants become covered in a white powdery film. Severely affected foliage turns blue-grey.

Clouds of spores can be shaken from heavily infected crops.

Tissue below infected areas may be purplish.

Severe pod infection can cause a grey-brown discolouration on the seed.

Yield is unlikely to be affected if occurs in the last four weeks of the growing season.

**Management**
Grow resistant varieties.

Late sowing increases likelihood of the disease.

Fungicide sprays provide control, but application at first sign of disease is critical.

**Images:** M Ramsay, formerly SARDI; T Yeatman, Rural Solutions SA; W Hawthorne, Pulse Australia
Root rot (*Fusarium, Rhizoctonia*)

**Description**
Plants are often stunted with yellow lower leaves. They may initially look normal but wither and die under stress.

There are fewer pods with reduced number of seeds.

Poorly developed root systems; sunken light brown to black patches on tap root; lower roots severely rotted.

Rhizoctonia can rot-off hypocotyls, preventing emergence; seeds may have several rotted shoots.

Worse with reduced tillage, poor fertility (especially zinc), and can build-up on weed roots prior to sowing.

Favoured by warm soil and conditions susceptible to poor root growth such as marginal or excessive moisture.

**Management**
Eliminate green growth at least four weeks prior to sowing.

Provide adequate nutrition and conditions for rapid root growth.

Disturb soil several centimetres below the seed to reduce infection in the soil.
**Septoria blotch** *(Septoria pisi)*

**Description**
Yellow blotches limited by leaf veins on the lower, older parts of the plant.

Blotches vary in size and may merge to cover the whole leaf.

Diseased areas may die, becoming straw coloured and angular on leaves, stems and tendrils.

Numerous brown spots (fruiting bodies) develop on dead tissue.

Occurs in extended periods of high humidity and warm temperatures.

**Management**
Use disease free seed.

Avoid sowing into or near infected pea trash.

*Images: M Ramsay, formerly SARDI*
Sclerotinia (*Sclerotinia sclerotiorum*)

**Description**
In wetter seasons, often found together with botrytis grey mould. Appears mainly on older plants. Water soaked patches on stems and leaves develop a soft, slimy rot exuding droplets of a brown liquid. When dry, a fine white fungal growth including black sclerotes develops. Affected plants wilt and rapidly die. They are smaller and discoloured.

**Management**
Use disease free seed, free of sclerotes. Do not grow in close rotation with canola, pulses and broadleaved weeds such as capeweed. Avoid sowing adjacent to infected stubble. Eliminate infected stubbles. Grow a cereal for three years rather than a broadleaf crop (pulse, oilseed, clover), and control all broadleaf weeds and legume pastures.

*Sclerotinia* sclerotes on a stem.

*Sclerotinia* growth on lentils.

Stem lesion caused by *sclerotinia*. Note fungal growth (fungal sclerotes develop in this area)

*Images:* J Davidson, SARDI
Stem nematode (*Ditylenchus dipsaci*)

**Description**
Plants become yellow-green, with severe stunting and malformation in patches.
Leaves curl and develop water-soaked areas.
Thickened bases and multi-stems; black streaks on lower stem; stems may die back.
Herbicide damage and mites can produce similar symptoms of leaf curling.
Build-up is worse in wet conditions.

**Management**
Sow nematode free seed.
Do not introduce through infected straw/hay.
Avoid rotations of susceptible crops and weeds e.g. oats and bedstraw, that increase nematode populations.

**Images:**
M Ramsay, formerly SARDI; J Nobbs, SARDI

Stem nematode often occurs in patches.

Stem nematode causes pea plants to become severely stunted and distorted.

Stem nematode is a parasitic nematode affecting oats and pulses.

Images: M Ramsay, formerly SARDI; J Nobbs, SARDI
Field peas do not compete with weeds well and varieties with poor early vigour have less ability to compete with weeds. Bulky varieties and varieties which remain erect, e.g. Kaspa\textsuperscript{(b)}, compete better with weeds late in the season than varieties which lodge, e.g. Parafield.

It is essential to plan your weed control strategy before sowing. Delaying sowing is an option in most areas except lower rainfall areas. This can enable several weed kills before sowing. The application of pre-emergent herbicides is also a useful strategy. Most grass weeds can be controlled either pre or post-emergence. There are more post-emergent herbicide options for peas than for other pulses.

Take care to apply the herbicide at the right stage of pea and weed growth. Applying herbicide to diseased peas or by adding oil can increase the development of the disease.

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

Paddocks such as this with cut leaf mignonette may need to be avoided.

Crop topping is a powerful tool for weed control.

Images:
W Hawthorne,
Pulse Australia;
P Matthews, NSW DPI
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.

Effects of herbicide injury may vary, depending on the dose received and crop susceptibility. Herbicide damage may be very obvious, such as with scorched leaves, or may be 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, the crop and seasonal conditions.

Herbicide crop injury symptoms can easily be confused with symptoms produced by other causes, such as from frost, insect damage, 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.

Image: T Yeatman, Rural Solutions SA

Affected paddock – herbicide damage? Why did it occur?
WEED MANAGEMENT

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>
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</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

Visual symptoms appear 5 to 8 days after spray application or where there are residues in the soil.

Seedlings may emerge and grow for several weeks before plants become stunted with shortened internodes. New foliage has a yellow to red to purplish colouration which progresses throughout the plant. Leaf curl may be apparent.

Growth of lateral roots may be reduced.

Management

Follow plant-back periods as indicated on label where high pH calcareous soils (> pH_{CaCl2} 7.5).

Cold, wet conditions and compacted soil (e.g. wheel tracks) can be contributing factors, as is zinc deficiency, and conditions that stress and prevent the plant recovering.

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

A Group B herbicide can result in more significant crop damage when applied where Group B residues exist.
Metsulfuron drift.

Metsulfuron symptoms. New growth yellow/red.

Peas affected by sulfonyl urea herbicide residues.

Flumetsulam symptoms. Yellowing of new growth.

Peas-Metsulfuron drift damage. Yellowing of new growth.

General yellowing of pea plants caused by Flumetsulam damage.

Images: VDPI; T Yeatman, Rural Solutions SA; M Wurst, Rural Solutions SA; M Ramsay, formerly SARDI
**WEED MANAGEMENT**

**Group C**

**Inhibitors of photosynthesis**

<table>
<thead>
<tr>
<th>Triazine</th>
<th>Triazinone</th>
<th>Urea</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical name</td>
<td>Trade name*</td>
<td>Chemical name</td>
</tr>
<tr>
<td>atrazine</td>
<td>Gesaprim®</td>
<td>metribuzin</td>
</tr>
<tr>
<td>simazine</td>
<td>Gesatop®</td>
<td>Nitrile</td>
</tr>
<tr>
<td>terbutryn</td>
<td>Igran®</td>
<td>bromoxynil</td>
</tr>
</tbody>
</table>

*Representative products of many for most chemicals.

**Description**

Visual symptoms appear as weeds emerge (where soil applied) or 4–6 days after spray application to emerged weeds.

Symptoms develop rapidly but require light. Rapid yellowing and necrosis beginning at the edge of leaves occurs leading to their desiccation and burnt appearance. Interveinal chlorosis or veinal chlorosis can occur.

Tolerant plants (crops) often recover.

Atrazine symptoms. Interveinal chlorosis.
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.

Damage is most likely from herbicide leaching into seed furrows after heavy rainfall in ridged soils and where there is shallow sowing.

Herbicide leached into root zone causing seedlings to die.

Unaffected plant (left); Pea plant affected by diuron (right).

Images: T Yeatman, Rural Solutions SA; Unknown
Group D
Inhibitors of cell division

<table>
<thead>
<tr>
<th>Dinitro-anilines (DNAs)</th>
<th>Benzamides</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical name</td>
<td>Trade name*</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.

*Image: M Ramsay, formerly SARDI*
Management
Avoid sowing seed into the layer of herbicide treated soil. This often occurs from the seeder set-up resulting in variable depth of sowing, or from sowing too fast throwing herbicide treated soil onto adjacent furrows.

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

Trifluralin affected seedling.

Seedlings struggling to emerge.

Trifluralin can cause emergence problems in field peas.

Images: W Hawthorne, Pulse Australia
Group F
Inhibitors of carotenoid biosynthesis

<table>
<thead>
<tr>
<th>Nicotinanalides</th>
<th>Picolinamide</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical name</td>
<td>Chemical name</td>
</tr>
<tr>
<td>Trade name*</td>
<td>Trade name*</td>
</tr>
<tr>
<td>diflufenican</td>
<td>picolinafen</td>
</tr>
<tr>
<td>Brodal®</td>
<td>Sniper®</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).

Pea plants turn light green and whole leaves turn yellow to cream colour.

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

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

Images: D Lemerle, NSW DPI; M Wurst, Rural Solutions SA
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></td>
<td>Striker®</td>
<td></td>
</tr>
<tr>
<td><strong>N-diphenylphthalamides</strong></td>
<td></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 peas although grasses and cereals generally recover.

**Management**
Ensure that herbicide drift does not occur onto field peas crops, especially where fine droplets are targeted for the use of products as indicated by the label.

*Images: T Yeatman, Rural Solutions SA; W Hawthorne, Pulse Australia*
## 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><strong>Chemical name</strong></td>
<td><strong>Trade name</strong>*</td>
<td><strong>Chemical name</strong></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 3–4 days of application. Plants start to twist and appear misshapen with epinastic 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.

### Management
Do not sow if there is a risk of residues from pre-sowing herbicide application.

Ensure that herbicide drift does not occur onto field peas crops.
Group I continued

MCPA® symptoms.

Clopyralid symptoms, twisted stems.

Group J
Inhibitors of fat synthesis

<table>
<thead>
<tr>
<th>Thiocarbamates</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Chemical name</strong></td>
</tr>
<tr>
<td>tri-allate</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. Affects 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>Chemical name</th>
<th>Trade name*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>metolachlor</td>
<td>Dual®</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.

Affects are more severe in light textured soils with low organic matter and also in waterlogged conditions, where crops are stressed from lack of moisture or lack of nutrients, and when frost occurs within 10 days of application.
Group L
Inhibitors of photosynthesis (photosystem I)

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

Typical symptoms of necrotic white areas with brown borders from paraquat damage on a Navy bean leaf.

Images: QPIF
Group M
Inhibitors of amino acid synthesis

<table>
<thead>
<tr>
<th>Glycines</th>
<th>Chemical name</th>
<th>Trade name*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>glyphosate</td>
<td>Credit®</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Roundup®</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Touchdown®</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.

Plant looks flaccid and tend to lie on the soil surface.

Management
Ensure that herbicide drift does not occur onto field pea crops.

Glyphosate symptoms.

Glyphosate drift damage.

Pea plant affected by glyphosate herbicide spray.

Yellowing and twisting of tendrils.

Images: QPIF; VDPI;
M Wurst, Rural Solutions SA;
C Preston, University of Adelaide
Effective weed control

Ensure a low seed bank of hard to control weeds and control weeds when they are smaller. This 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 the weed.

Weeds such as bedstraw and bifora once limited the planting of field peas, but recent herbicide developments now enable control of these weeds. Lack of crop competition from field peas to annual ryegrass also resulted in ryegrass infested crops, but use of crop topping has helped make peas a more robust part of a rotation. The control of vetch and medic in field pea crops still 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 15 km/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.

Weeds can compete strongly and reduce the value of a field pea crop.

Images: 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>
<tr>
<td></td>
<td><strong>Herbicides</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Knockdown herbicides</td>
<td>Glyphosate or paraquat plus spike for difficult to control weeds</td>
</tr>
<tr>
<td></td>
<td>Double knockdown</td>
<td>Glyphosate followed by paraquat three to four days later</td>
</tr>
<tr>
<td></td>
<td>Pre-emergent herbicides</td>
<td>Trifluralin (Group D) + Dual® Gold (Group K) or Avadex® (Group E) mix</td>
</tr>
<tr>
<td>Tactic</td>
<td>Management</td>
<td>Practical issues</td>
</tr>
<tr>
<td>---------------------------------------</td>
<td>-------------------------------------------</td>
<td>----------------------------------------------------------------------------------</td>
</tr>
<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>Cut for hay</td>
<td>This may be the best longer term option where there are high numbers of resistant weeds</td>
<td></td>
</tr>
<tr>
<td>Windrowing</td>
<td>Will reduce seed set</td>
<td></td>
</tr>
<tr>
<td>Crop topping</td>
<td>Apply Roundup Power Max® or paraquat to kill surviving plants/stop seed set</td>
<td></td>
</tr>
<tr>
<td>Prevent viable weed seeds being added to seed bank</td>
<td>Weed seed collection at harvest</td>
<td>May be impractical; slowing harvest, demand on header power, disposal of weed seeds</td>
</tr>
<tr>
<td></td>
<td>Weed seed destruction at harvest</td>
<td>Not yet available; greater power requirement; degree of effectiveness</td>
</tr>
<tr>
<td></td>
<td>Narrow header rows</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>
Field peas should be self sufficient for nitrogen if well nodulated. Rates of 10–20 kg/ha of “starter” nitrogen to aid early growth may be useful on lighter and slightly acid soils.

Phosphorus removal is about 4 kg per tonne of grain. Apply phosphorus 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 phosphorus availability.

Use tissue testing to monitor the availability of trace elements. Zinc is required for field peas on alkaline soils. It should be applied to the soil every 2–7 years depending on soil type. Manganese is sometimes required for field peas on highly alkaline soils or under fluffy soil conditions. Foliar applications of iron may be needed for field peas grown on highly alkaline and wet soils. Field peas may respond to molybdenum in soils that are deficient.

Crop yellowing from a nutrient deficiency may be as a result of many causes.
As for other crops, field peas 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.

The main deficiencies encountered in field peas are:

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Deficiency 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**

Field peas 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 affect acidic soils generally unsuitable for peas.

**Guide to nutrient removal in one tonne of pea grain**

<table>
<thead>
<tr>
<th>Major nutrients (kg)</th>
<th>Minor nutrients (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen N 40</td>
<td>Copper Cu 7</td>
</tr>
<tr>
<td>Phosphorus P 3.9</td>
<td>Zinc Zn 28</td>
</tr>
<tr>
<td>Potassium K 8</td>
<td>Manganese Mn 14</td>
</tr>
<tr>
<td>Sulphur S 1.8</td>
<td></td>
</tr>
<tr>
<td>Calcium Ca 0.7</td>
<td></td>
</tr>
<tr>
<td>Magnesium Mg 0.9</td>
<td></td>
</tr>
</tbody>
</table>

**Images:**

T Dooley, Rural Solutions SA; A Robson, University of WA

Soil salinity affecting large areas of the crop.

Boron toxicity symptoms on the leaf, right; and boron adequate leaf, left.
### Key to deficiencies in field peas

<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><strong>Deficiency</strong></td>
<td>N</td>
<td>P</td>
<td>K</td>
</tr>
<tr>
<td>CHLOROSIS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Complete</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mottled</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Interveinal</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crescent form</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NECROSIS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Complete</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distinct areas (including spotting)</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Margins</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Tips</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>PIGMENTATION within necrotic or chlorotic areas</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Opaque</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Light brown</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brown</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pink</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>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Wilting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Twisting</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Puckering</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>Rosetting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tendril distortion</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Internode shortening</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stem lesions</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>x</td>
<td>x</td>
<td>x</td>
</tr>
</tbody>
</table>

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

Image: A Robson, University of WA
Iron deficiency

Description
Often appears in young plants related to soil type where there is a high lime content under 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. Deficiency then spreads to older leaves, and young growth stops. Stems become slender and shortened.

Management
Leaf tissue tests indicate the plant’s iron status at sampling.

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

Treat with foliar iron before symptoms appear if high pH, calcareous soils in a high rainfall area.

Images: W Hawthorne, Pulse Australia; M Seymour, DAFWA; J McFarlane, Rural Solutions SA
Manganese deficiency

Description
Is common on highly alkaline calcareous soils. Is worse on fluffy soils with wheel tracks not as badly affected.

Younger leaves show yellowing between the veins, often in specks.

Deficiency late in the season may lead to discolouration, splitting and deformity of seeds called ‘marsh spot’.

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: M Ramsay, formerly SARDI; A Robson, University of WA
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.

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 zinc status at sampling.

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

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

There are none or few 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, with older leaves being 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 covered with viable Group E 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>
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<tr>
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<tr>
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<td>Few</td>
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<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; R Ballard, SARDI
Frost

Description
Frost during flowering and podding can cause significant yield loss and damage to the grain. During flowering plants will drop flowers and abort setting pods after a frost.

During pod filling frost can damage immature grain to prevent it from further development. One or all of the grains in a pod may be affected. Grain that is nearly mature may become discoloured and misshapen.

Management
Sowing later or using later maturing varieties may help reduce the risk of frost. Rolling or claying sandy surface soils will reduce the severity of frost. Sowing in a north-south direction might reduce frost risk, as would sowing down hill to channel cold air away. Avoid sowing peas in areas prone to severe frost damage.

Images: W Hawthorne, Pulse Australia; A Mayfield, Allan Mayfield Consulting; M Ramsay, formerly SARDI; Grain Legume Handbook; E Armstrong, NSWDPI
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, particularly under low soil moisture conditions.

**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.

*Images: W Hawthorne, Pulse Australia*
WEATHER DAMAGE

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 swath through the crop as well as neighbouring crops in its path.

Management
Invest in adequate hail insurance.

Use non-shattering varieties, e.g. Kaspa\(^b\), to minimise pod losses.

Hail damage in field peas, pods are flattened and curved, with white spots on the outer skin.

Image: M Ramsay, formerly SARDI
Heat

Description
Can cause flower abortion if occurring in the reproductive stage.

Dark markings on the seed coat where very high temperatures and lack of subsoil moisture occur during late pod fill causing premature senescence.

The germination ability of affected seed is not necessarily reduced.

Management
Check the germination of affected seed with a germination test.

Smaller seed should be graded out to ensure seedling establishment and vigour.

Select a variety and seeding date to avoid periods of high temperature during pod fill.

Images: T Yeatman, Rural Solutions SA; J Brand, VDPI
WEATHER DAMAGE

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 pea paddock.

Delay sowing in higher rainfall areas.

Sow into raised beds.

Images: W Hawthorne, Pulse Australia; T Yeatman, Rural Solutions SA
Bluegreen aphid (*Acyrthosiphon kondoi*)

**Description**
Adults are 3 mm long, may have wings, vary from grey-green to blue-green and 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 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 up to 2 mm long, may have wings, and are shiny black. Nymphs are dull grey, but 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. This aphid can vector many plant virus 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, may be 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. 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.
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 with a greasy appearance, 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 the ground level on the leaves or stem. Large larvae often cut through the stems of young seedlings, hence the name ‘cutworms’.

*A. 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, are dark brown to grey with a yellow line along the back either side of a conspicuous dark band. They have a red colouration surrounding 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 per year.

Larvae feed on leaves and are usually present 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.

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Images: SARDI; DAFWA
Looper caterpillar \textit{(Chrysodeixis sp.)}

\textbf{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.

\textbf{Management}
Larvae may be noticed when checking for other pests but do not require special attention.

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

\textbf{Images:} DAFWA; P Reid, QPIF
Lucerne seed web moth (*Etiella behrii*)

**Description**
Newly hatched larvae are approximately 1 mm in length and are light orange. As larvae develop, their body colour changes to a pale green, sometimes cream, with distinctive pink stripes. Mature larvae are up to 10–12 mm long and pinkish red in colour. Adults are grey, 10–15 mm long with a protruding beak.

The forewing has a distinctive white stripe running along its full length. At rest, the wings are folded over the body making the moth appear long and slender. Up to three generations occur per year from spring to autumn.
Eggs are commonly laid in the calyx of developing pods. Larvae bore into pods within a short time of hatching and begin feeding on developing seeds. This results in yield loss and a reduction in quality. Larvae can web several pods together to continue feeding.

**Management**
Regularly monitor for adults using a sweep net from the onset of pod formation. Time insecticide application at adult moths within the crop prior to their laying eggs.

The degree-day model can be used to identify the onset of significant *Etiella* flight activity within crops. The model requires daily temperatures to be entered from June 21. The date when the cumulative total of degree-days first reaches 351 is the date to start monitoring in the crop.


**Biocontrols**
Glossy shield bug and spined predatory shield bug.

Images: SARDI ; Grain Legume Handbook
Native budworm and corn earworm or cotton bollworm
(*Helicoverpa punctigera* and *Helicoverpa armigera*)

**Description**
Larvae are up 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 and bristles and long stiff black hairs. Newly hatched larvae are light in colour with tiny dark spots and dark heads. As larvae develop they become darker in colour and the darker spots become 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.

Images: SARDI; L Turon & M Cahill, QPIF; DAFWA; M Seymour, DAFWA
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 years 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 when conditions are wet. Check during the warmer part of the day when they are most active. Look for damage and the presence of mites on clovers and *Brassica* weeds before sowing and examine crops at emergence. Early control of summer weeds in paddocks that are to be cropped will prevent the build up of mite populations.

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 give better control over *Bryobia* than synthetic pyrethroids. Rates of insecticides commonly used to control RLEM are generally not effective against *Bryobia* mites.

Images: CESAR
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 pinkish-orange with six legs and are only 0.2 mm long. Redlegged earth mites generally feed in large groups of up to 30 individuals. They are active from autumn to late spring and 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. Rotating crops or pastures with non-host crops or cultivation can reduce pest colonisation.
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.

The pest works 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 with numbers tending to peak in late spring.

Although a more serious pest of young crops, they can also damage older crops. It is important to check for insects and damage in paddocks with high humidity and moisture.

**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.

If warranted, treat the infested area approximately three weeks after lucerne flea first infests the crop. This will allow for over-summering eggs to hatch but before they lay winter eggs. Pea crops are likely to suffer damage following a weedy crop or pasture in which lucerne flea have not been controlled. Lucerne flea control is recommended the season prior to sowing field peas.

**Biocontrols**
Pasture snout mites and spiny snout mites prevent outbreaks of this pest when in sufficient numbers.

Images: CESAR

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Adult.

Damage to clover.
Pea weevil (*Bruchus pisorum*)

**Description**
Not a true weevil as it does not have the typical weevil snout. The adult is a chunky beetle about 5 mm long, generally brownish flecked with white, black and grey patches. The tip of the abdomen extends beyond the wing covers and is white, with two black oval spots. Eggs are yellow, cigar shaped, about 1.5 mm long and laid singularly on young green pods in spring.

Adults migrate into crops from nearby hibernating shelters when spring temperatures are above 18° C. Larvae are legless, curled, cream grubs that grow to 5 mm long and are confined inside the seed. They hollow out the seed, reducing yield and quality. They may remain in harvested grain and seed retained for planting.

**Management**
Check crops regularly, especially around crop edges using a sweep net at the time of first flowering until the crop begins to dry. To prevent crop damage control adults by applying a well timed border spray before eggs are laid on pea pods.
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 beneficals 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.

Glossy shield bug, adult.

Glossy shield bug, nymph.

Assassin bug, adult.

Spined predatory shield bug, nymph.

Images: SARDI; CESAR; J. Wessels, QPIF; DAFWA
BENEFICIAL ORGANISMS

**Flies**

Hover fly, adult.

Tachinid fly, adult.

Hover fly, larva.

**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.

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.

*Images:* D Ironside, QPIF; VDPI; P. Reid and C. Mares, QPIF; NSW Agriculture
**Aphid wasps**

*Aphidius ervi* on bluegreen aphid.

*Trioxys complanatus* wasp.

Parasitised aphid (mummy on the left).

**Spiders**

Wolf spider.

Jumping spider.

Aphid mummy with parasite exit hole.

**Images:** 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
**Round or white snails** (*Theba pisana* and *Cernuella virgata*)

### Description

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 affects marketability. They over summer off the ground on stubble, posts, etc and especially on green weeds and in some areas are a major contaminant of grain.

<table>
<thead>
<tr>
<th>Snail</th>
<th>Snails over 7 mm/sq metre</th>
<th>Bait required kg/ha</th>
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<tr>
<td>Round or white snails</td>
<td>Less than 80</td>
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</tr>
<tr>
<td>Conical snails</td>
<td>No threshold established</td>
<td>5 kg/ha</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 growing season to detect any snail movements, particularly from the edges of paddocks.

*Cernuella vergata*, note open circular umbilicus and continuous brown markings.
Pointed or conical snails (*Cochlicella acuta* and *Cochlicella barbara*)

**Description**
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.

They both 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. Often 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. Build up in numbers in the pasture phase of cropping rotations.
Management
Concentrate monitoring between January and April. Threshold numbers for control for *C. barbara* in field peas have not been established. 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 movement, particularly from the edges of paddocks.

Biocontrol
Sarcophagid parasitic fly *Sarcophaga penicillata*.

Conical snail infestation.

Images: SARDI
Salinity

Description
Plants are stunted with yellowish discoloration 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.

A saline corner of a paddock.

Extensive plant loss due to salinity.

Images: T Dooley, Rural Solutions SA
Lodging

Description
Leads to shading other plants, loss of flowers and pods and increased incidence and severity of leaf disease. More likely in later and higher rainfall areas.

Tall trailing types with poor resistance to lodging (e.g. Parafield) are more likely to lodge in spring. Areas of ground exposed by lodging enable late spring weeds to grow and set seed, of particular concern for the management of annual rye grass.

Difficulty in lifting the crop at harvest makes harvesting more difficult, slower and less efficient.

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

Sow later to match sowing time with the environment in which it is grown not to grow excessive bulk.

Crop lifters will aid harvesting lodged crops.

Harvest early and prior to wet or windy weather as delays lead to even greater lodging.

Windrowing crops prone to lodging may aid harvest.

Images: W Hawthorne, T Bray, Pulse Australia

Lodged crop prostrate on the ground make harvest more difficult.

Plants in Kaspa plots stand up well.

Parafield plants naturally tend to become more lodged and harder to reap.
OTHER DISORDERS

Poor colour

Description
Can be caused by pre-mature ripening (‘green kernel’) due to heat, drought or disease stress, or harvesting immature seed. Delayed harvest, rain at harvest, disease, frosting and a dry hot finish can also cause poor grain colour. Seed coats can darken with age, especially dun peas, but can be acceptable if the whole sample is uniformly coloured.

Prolonged wet weather damage may lead to poor colour, loose seed coat, wrinkled or other defects.

Blue peas can be severely bleached (‘yellow kernel’) by heat and sun.

The split cotyledons of blue peas change to a yellow-white colour with age. Dun peas darken with age.

Black grain can be an unacceptable contaminant reaped from flattened wheel tracks in wet conditions. They can also be mouldy.

Management
Harvest field peas as soon as possible.
Crop top or desiccate at the right time.
Store in good storage conditions.

Green kernels from premature ripening found in a yellow split sample.
CROP DEVELOPMENT

OTHER DISORDERS

Normal grain left and severely bleached blue peas right.

Green discolouration of white peas right due to heat, drought, or disease stress, or premature harvest.

Good colour left, slight centre, severe discolouration right.

Grain discolouration due to blackspot.

Green kernels caused by premature ripening by the season, or crop topping or desiccating too early.

Seed coat discolouration from heat burn when exposed to excessive heat in pod.

Images: C Palmer; W Hawthorne, Pulse Australia; T Yeatman, Rural Solutions SA
Peas can be grown specifically for forage, or grown as a flexible option between grain or forage to manage risks of frost, drought or weeds.

Forage pea varieties are usually taller, bulkier, late flowering and small seeded (e.g. Morgan®).

Sowing for forage is often early, so disease management is important.

Seeding rates for forage are higher than for grain, or peas can be sown in a mixture with oats or triticale to provide greater bulk.

New sowing seed supplies need to be organised.

Additional erosion, soil compaction and nutrient loss implications need be considered.

Financial calculations are needed before making the forage versus grain decision.

### Quality

- Forage harvest can be as hay, silage, grazing or as ‘green or brown manure’.
- Pea hay and silage quality is similar to clover or vetch hay and price should also be similar.
- Pea forage quality slowly diminishes after flowering as bulk increases and seed fill progresses.
- As with vetch, conditioning or super-conditioning of pea forage helps drying of pods and stems.
- Unlike cereals, frosted peas do not have to be cut for forage immediately to preserve forage quality.
- Measure pea forage quality with a FEEDTEST® or a NSW DPI Feed Quality Service test.
### Metabolisable Energy (Mj/Kg DM), Crude protein (%), Dry matter digestibility (%)

<table>
<thead>
<tr>
<th></th>
<th>Metabolisable Energy (Mj/Kg DM)</th>
<th>Crude protein (%)</th>
<th>Dry matter digestibility (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pea forage (e.g. hay)</td>
<td>8.0-11.0</td>
<td>12-20</td>
<td>60-70</td>
</tr>
<tr>
<td>Cereal hay</td>
<td>7.5-9.0</td>
<td>6-12</td>
<td>55-75</td>
</tr>
<tr>
<td>Pea straw</td>
<td>6.0-7.0</td>
<td>&lt;5.0</td>
<td>35-50</td>
</tr>
<tr>
<td>Cereal straw</td>
<td>5.0-6.5</td>
<td>&lt;4.0</td>
<td>35-50</td>
</tr>
</tbody>
</table>

Individual samples can test differently than ranges indicated. Field pea hay measured by FEEDTEST® on a dry matter basis ranges have been: Metabolisable Energy (ME) 5.1 to 12.5 Mj; crude protein (CP) from 4.5 to 23.1%; and digestibility (DMD) from 38.0 to 81.8%.

Pea swath cut for hay.

Pea hay and silage provide high feed value to stock.

Images: W Hawthorne, T. Bray, Pulse Australia
Desiccaton is used in field peas to ensure even ripening of the crop allowing earlier and easier harvest and to ‘brown off’ late weed infestations to improve the ease of harvest. It advances pea maturity up to 10 days.

Spray once seeds have reached physiological maturity and moisture is at 30%, usually 20 days after the end of flowering. The lower 75% of pods are brown. Seeds are firm with thin and leathery shells. Harvest 5–10 days after desiccation.

Crop topping ripens field peas earlier, but is timed to control seed set in escape weeds, normally ryegrass. Optimal time for controlling weed seed set may conflict with maximum grain yield of the pea crop. Time the crop topping operation as late as possible (i.e. the dough stage of the ryegrass), when 50% or more seeds within the pods have changed from green to yellow.

Earlier maturing varieties allow 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 an increased proportion of small, green, immature seeds within the sample.

Coloured foam markers can stain pea seed through the pods. Observe all withholding periods to avoid grain residues.
Weed wiping

Weed wiping is used successfully in field peas to prevent seed set of ryegrass and other tall weeds that stand above the crop. Crop height needs to be considered in choosing a variety.

Windrowung

Windrowing field pea crops for uniform ripening and earlier harvest has been considered impractical as windrows often lack bulk and tend to be blown around in strong winds when left to dry.

Windrowing has been successful with semi-leafless peas like Kaspa®, with similar flow problems and modification solutions to belt front harvesters being required.

Windrows must be from wide swathes placed into a bulky windrow and rolled immediately after using a ‘cotton wheel roller’ to compact the windrow.

Windrowing directly in front of the harvester to reduce snail contamination in the sample has been successful, but does not assist uniform and early crop ripening.

Images: M Seymour, DAFWA
Harvest timing

Harvest as soon as the crop has matured and grain moisture does not exceed 14%. Harvesting pea crops early improves quality and harvest efficiency. Desiccate or crop top to ripen crops uniformly allowing earlier harvest. Crops harvested later when conditions are very dry, have greater grain losses, a higher proportion of split and broken grain (defectives), and increased levels of ascochyta blight and weather damage.

If harvest is delayed, seed becomes brittle, discoloured, prone to mould and germination is reduced. The ‘sugar pod’ trait in some pea varieties like Kaspa and Bundi reduces pod shattering and helps to prevent seed loss before and during harvest. The trait will not prevent seed quality decline if harvest is delayed.

Field peas are ready to harvest when the pods are leathery and wrinkled and the vine not completely dry. Not all harvesters can handle ripe pods and moist stems. Harvesting difficulties arise where harvest is delayed until grain moisture is below 12%.
Tips for harvesting

- Harvest as soon as the peas are mature.
- Harvest early in the day or into evening; humidity reduces seed shatter; avoid cool damp conditions. Semi-leafless types (e.g. Kaspa\(^{(a)}\)) require warmer conditions than conventional types (e.g. Parafield).
- Crop lifters are usually required with conventional field peas and very short semi-leafless crops.
- Flexible fingers are a useful addition above a plucker.
- A flex front is ideal.
- Open fronts harvest field peas successfully if the paddock surface is level, crop canopy dense and free of weeds. Crop lifters may be required.
- Pick-up fronts give good results with conventional field peas under a range of conditions.
- Avoid excessive harvest speed to minimise feeding problems.
- Harvest lodged crops into or across the direction in which the crop lies.
- Set drum or rotor speed at 300–600 rpm; fan speed 60–75 %; top sieve 20–25 mm; Bottom sieve 10–15 mm
- Use a desiccant if summer weeds would otherwise prevent early harvest.
Suggested harvest settings or modifications for conventional and semi-leafless peas

Harvesting problems with Kaspa\(^a\) can often be associated with belt (draper) fronts or excessive harvest speed.

<table>
<thead>
<tr>
<th>Factor</th>
<th>Trailing varieties (e.g. Parafield)</th>
<th>Semi-leafless (e.g. Kaspa(^a))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harvest timing</td>
<td>Cool conditions</td>
<td>Warm conditions</td>
</tr>
<tr>
<td>Crop lifters</td>
<td>Essential</td>
<td>Not needed in an upright crop</td>
</tr>
<tr>
<td>Finger tyne adjustment</td>
<td>Tilt back slightly – assists lifting</td>
<td>Set in vertical position to force material down and into draper fronts</td>
</tr>
<tr>
<td>Reel Speed</td>
<td>1.1 times ground speed</td>
<td>1.0–1.3 times ground speed</td>
</tr>
<tr>
<td>Raised cross auger</td>
<td>Usually not required</td>
<td>Improves speed of harvest of pluckers.</td>
</tr>
<tr>
<td>Raised cross auger with paddles on middle section</td>
<td>Usually not required</td>
<td>Essential for draper fronts</td>
</tr>
<tr>
<td>Lupin breakers</td>
<td>Usually not required</td>
<td>On cross auger for draper fronts and table auger for conventional fronts.</td>
</tr>
<tr>
<td>Position of broad elevator feeder house auger</td>
<td>Set back</td>
<td>Move the feeder house auger forward may reduce blockages</td>
</tr>
<tr>
<td>Stripper plate</td>
<td>–</td>
<td>To stop material building behind cross augers</td>
</tr>
<tr>
<td>Wire fence across back of fronts</td>
<td>Useful addition</td>
<td>Assists in light crops – raised cross auger + paddles more reliable</td>
</tr>
<tr>
<td>Concave</td>
<td>Easy to thresh 10–25 mm</td>
<td>Ensure wire gaps at least 7 mm and not blocked</td>
</tr>
<tr>
<td>Straw chopper</td>
<td>Useful addition</td>
<td>Essential due to ropey vine</td>
</tr>
</tbody>
</table>
Modifications for conventional and semi-leafless peas

Problems with a tin front, plucker and Kaspa®. Wire across draper fronts are unreliable on their own but may be a useful addition behind cross augers.

Adding paddles to the centre section of the cross auger improves the flow of material into the harvester. Moving the broad elevator auger forward can improve feeding of light material into the harvester. Cross augers and adding paddles to the centre section can improve the flow of light material on draper fronts.

Barrel plucker with cross auger harvesting Kaspa® at 9-11km/hr.

Images: M Seymour, DAFWA
Harvest for quality

Human food markets demand a quality sample without cracking, staining or insect damage. Visual appearance is everything. Buyers of blue peas do not want bleached, chipped, cracked or de-hulled seeds.

Early harvest is important for quality. The larger seed of peas make them prone to mechanical damage. Minimise seed damage and losses during harvest by harvesting early morning with a low drum speed and wide concave clearance. Axial or rotary harvest drums cause much less seed damage. Use minimum drum speed as field peas thresh readily. 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 setting and barley sieves. Pea seed is heavy compared with stem and leaf trash, so it is safe to use draft to remove trash.

If summer weeds are present, the drum speed may need to be increased, so that the weeds 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

To ensure maximum germination and minimal disease carryover choose an area of a paddock where there has been minimal disease, pest and weed infestation. Ensure headers, bins, augers and other equipment are free of cereal contamination as these grains are hard to remove during cleaning. Sprouting downgrades quality and germination is also affected.

Human food markets demand a quality sample. Visual appearance is everything.
Leaving a stable paddock

Pea stubble has the highest potential of all stubbles to erode, often caused by the stubbles being grazed over summer and autumn. Stubble is best chopped into small pieces and spread evenly rather than allowed to come out in long vines that roll up against fences, or form mounds creating a lumpy paddock. Erect plant types like Kaspa® are more likely to remain anchored in the soil after harvest.

Points to note

- Retain as much cereal stubble as possible on the surface after sowing peas.
- Keep seeding rates high for a dense crop.
- Roll or smooth the paddock to reduce harvest losses and grazing after harvest.
- Harvest early to reduce losses
- Use choppers and spreaders.
- Do not graze sandy surfaced soils.

If grazing the stubbles

- Graze for a short time only; most available grain is gone in about four weeks.
- Electric fences can fence off sensitive areas in a paddock.
- Cultivate on a summer rain.
- If not carefully managed, grazing will greatly increase the chance of wind erosion.

Ungrazed pea stubbles

- Have less potential for wind erosion and soil loss.
- May give additional yield and protein improvements in the following cereal crop.

Images: W Hawthorne, Pulse Australia; T Bray, Pulse Australia
Dun peas are mainly consumed as split product (dhal) or as flour.

<table>
<thead>
<tr>
<th>Type</th>
<th>Current variety</th>
<th>Old equivalent</th>
<th>Generalised market comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Larger size, pale brown, few dimples</td>
<td>Kaspa(^a)</td>
<td>–</td>
<td>Kaspa(^b) has established its own market, with its own distinct ‘sweet’ dun flavour. Its minimal dimpling improves splitting efficiency, and its uniformity and non-green colour is desirable in ‘whole’ markets. Seed coat uniformity is important, without mottling</td>
</tr>
<tr>
<td>Larger size, green-brown, dimpled</td>
<td>Parafield, Yarrum(^b)</td>
<td>Alma, Dunwa, Glenroy, Dundale, Early Dun, Paravic</td>
<td>The traditional dun pea market product. Has a distinct, slightly bitter taste. A greener seed coat may become a marketing issue if sold whole, even if the taste is sweet enough. Pronounced dimpling is a negative factor. Suit sprouting markets if leafy and not semi-leafless types</td>
</tr>
<tr>
<td>Medium size, green-brown, dimpled</td>
<td>–</td>
<td>Helena</td>
<td>Has fitted the traditional dun pea market product</td>
</tr>
<tr>
<td>Small size, green-brown, dimpled</td>
<td>Morgan(^b)</td>
<td>King</td>
<td>Main use is as a forage pea since too small for food markets</td>
</tr>
</tbody>
</table>

Dun Kaspa\(^a\).  
Dun Parafield.  
White.  
Blue.
### White pea market broad categories

<table>
<thead>
<tr>
<th>Type</th>
<th>Current variety</th>
<th>Old equivalent</th>
<th>Generalised market comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small size, creamy seed, rounded</td>
<td>Sturt</td>
<td>Kiley, Laura</td>
<td>Often stockfeed, as considered too small to split</td>
</tr>
<tr>
<td>Medium size, creamy seed, rounded</td>
<td>Bundi, SW-Celine</td>
<td>Cooke</td>
<td>Stockfeed, as often too small to consider splitting</td>
</tr>
<tr>
<td>Larger size, creamy seed, rounded</td>
<td>Moonlight, Snowpeak</td>
<td>Mukta, Santi,</td>
<td>The traditional white pea market for splitting, but small market size</td>
</tr>
<tr>
<td>Very large size, creamy seed, rounded</td>
<td>–</td>
<td>Bohatyr, Bonza</td>
<td>The specialised niche market preference</td>
</tr>
</tbody>
</table>

### Blue (‘green cotyledon’) pea market broad categories

<table>
<thead>
<tr>
<th>Type</th>
<th>Current variety</th>
<th>Old equivalent</th>
<th>Generalised market comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small or medium size, rounded</td>
<td>–</td>
<td>–</td>
<td>Stockfeed, as too small to split</td>
</tr>
<tr>
<td>Larger size, rounded</td>
<td>Maki</td>
<td>Soupa, Excell</td>
<td>The traditional blue (‘green cotyledon’) pea market for splitting, but small market size.</td>
</tr>
<tr>
<td></td>
<td>Bluey</td>
<td>–</td>
<td>The specialised niche market preference, depending on taste. Bleaching is a quality issue.</td>
</tr>
<tr>
<td>Very large size, rhomboid shape, wrinkled</td>
<td>Jupiter</td>
<td>–</td>
<td>The specialised niche market preference, often as a marrowfat</td>
</tr>
</tbody>
</table>
Field pea varieties may not necessarily be covered by PBR, but many have a number of different types of seed purchase agreements and royalty/marketing or levy arrangements that impact on marketing and sale of seed for sowing. Check any royalty/marketing arrangements and restrictions for that variety with the seed agent before purchase.

### Commercial buying and selling arrangements*

<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 category</th>
<th>EPR## per tonne</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bundi‡</td>
<td>PBR</td>
<td>DPI Vic</td>
<td>Premier Seeds</td>
<td>Premier Seeds</td>
<td>None</td>
<td>White</td>
<td>$5.50</td>
</tr>
<tr>
<td>Cooke</td>
<td>terminated</td>
<td>DAFWA</td>
<td>PlantTech</td>
<td>PlantTech</td>
<td>none</td>
<td>White</td>
<td>$1.24</td>
</tr>
<tr>
<td>Dunwa‡</td>
<td>PBR</td>
<td>DAFWA</td>
<td>COGGO Seeds</td>
<td>COGGO Seeds</td>
<td>none</td>
<td>Dun</td>
<td>$1.13</td>
</tr>
<tr>
<td>Excell</td>
<td>terminated</td>
<td>DPI Vic</td>
<td>None now</td>
<td>none</td>
<td>none</td>
<td>Blue</td>
<td>Nil</td>
</tr>
<tr>
<td>Glenroy</td>
<td>none</td>
<td>SARDI</td>
<td>None now</td>
<td>Seed not readily available</td>
<td>none</td>
<td>Dun</td>
<td>Nil</td>
</tr>
<tr>
<td>Helena‡</td>
<td>PBR</td>
<td>DAFWA</td>
<td>PlantTech</td>
<td>Retail outlets</td>
<td>none</td>
<td>Dun</td>
<td>$1.32</td>
</tr>
<tr>
<td>Jupiter‡</td>
<td>PBR</td>
<td>Cambridge Plat Breeders</td>
<td>UniGrain</td>
<td>UniGrain</td>
<td>Unigrain</td>
<td>Marrowfat</td>
<td>Nil</td>
</tr>
<tr>
<td>Kaspa‡</td>
<td>PBR</td>
<td>DPI Vic</td>
<td>AWB Seeds</td>
<td>AWB Seeds</td>
<td>none</td>
<td>Round Dun</td>
<td>$2.20</td>
</tr>
<tr>
<td>Kiley</td>
<td>terminated</td>
<td>Univ. Sydney</td>
<td>None now</td>
<td>none</td>
<td>none</td>
<td>White</td>
<td>Nil</td>
</tr>
<tr>
<td>King</td>
<td>withdrawn</td>
<td>DAFWA</td>
<td>None now</td>
<td>none</td>
<td>none</td>
<td>Dun</td>
<td>Nil</td>
</tr>
<tr>
<td>Laura</td>
<td>withdrawn</td>
<td>SARDI</td>
<td>None now</td>
<td>none</td>
<td>none</td>
<td>White</td>
<td>Nil</td>
</tr>
<tr>
<td>Magna</td>
<td>withdrawn</td>
<td>DAFWA</td>
<td>None now</td>
<td>none</td>
<td>none</td>
<td>Dun</td>
<td>Nil</td>
</tr>
</tbody>
</table>

*Current as of April 2009
<table>
<thead>
<tr>
<th>Variety</th>
<th>Status</th>
<th>Source</th>
<th>Registration</th>
<th>Licensee 1</th>
<th>Licensee 2</th>
<th>Color</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maki</td>
<td></td>
<td>NZ Inst. for Plant and Food Research</td>
<td>Univ. of Sydney</td>
<td>AGT (Sun Prime)</td>
<td>none</td>
<td>Blue</td>
<td>$4.40</td>
</tr>
<tr>
<td>Moonlight</td>
<td>terminated</td>
<td>NSW DPI</td>
<td>Premier Seeds</td>
<td>none</td>
<td>none</td>
<td>White</td>
<td>Nil</td>
</tr>
<tr>
<td>Morgan</td>
<td></td>
<td>NSW DPI</td>
<td>Hart Bros Seeds</td>
<td>Hart Bros Seeds Aust West Seeds</td>
<td>none</td>
<td>Dun</td>
<td>Nil</td>
</tr>
<tr>
<td>Mukta</td>
<td>withdrawn</td>
<td>SARDI</td>
<td>None now</td>
<td>none</td>
<td>none</td>
<td>White</td>
<td>Nil</td>
</tr>
<tr>
<td>Parafield</td>
<td>terminated</td>
<td>SARDI</td>
<td>PlantTech</td>
<td>Retail outlets</td>
<td>none</td>
<td>Dun</td>
<td>Seed royalty</td>
</tr>
<tr>
<td>Paravic</td>
<td>withdrawn</td>
<td>DPI Vic</td>
<td>None now</td>
<td>none</td>
<td>none</td>
<td>Dun</td>
<td>Nil</td>
</tr>
<tr>
<td>Santi</td>
<td>withdrawn</td>
<td>SARDI</td>
<td>None now</td>
<td>none</td>
<td>none</td>
<td>White</td>
<td>Nil</td>
</tr>
<tr>
<td>Snowpeak</td>
<td>terminated</td>
<td>DPI Vic</td>
<td>None now</td>
<td>none</td>
<td>none</td>
<td>White</td>
<td>Nil</td>
</tr>
<tr>
<td>Soupa</td>
<td>withdrawn</td>
<td>SARDI</td>
<td>None now</td>
<td>none</td>
<td>none</td>
<td>Blue</td>
<td>Nil</td>
</tr>
<tr>
<td>Sturt</td>
<td></td>
<td>DPI Vic</td>
<td>Premier Seeds</td>
<td>Premier Seeds</td>
<td>none</td>
<td>White</td>
<td>Seed royalty</td>
</tr>
<tr>
<td>SW Celine</td>
<td></td>
<td>PBR</td>
<td>Cambridge Plant Breeders</td>
<td>Crop Care Seed Technologies</td>
<td>Crop Care Seed Technologies</td>
<td>none</td>
<td>White</td>
</tr>
<tr>
<td>Yarrum</td>
<td></td>
<td>PBR</td>
<td>NZ Inst. for Plant and Food Research</td>
<td>Univ. of Sydney</td>
<td>AGT (Sun Prime)</td>
<td>none</td>
<td>Dun</td>
</tr>
<tr>
<td>Magna</td>
<td>withdrawn</td>
<td>DAFWA</td>
<td>None now</td>
<td>none</td>
<td>none</td>
<td>Dun</td>
<td>Nil</td>
</tr>
</tbody>
</table>

Source: Pulse Australia, April 2009.  
# PBR = Plant Breeders Rights.  
## EPR = End point royalty.
Receival standards

National receival standards for field peas set by the pulse industry through Pulse Australia reflect market requirements for a quality product. Pea types (dun, white, blue) are segregated with off-types becoming part of defective counts. Failure to achieve a receival standard may mean price discounts or re-cleaning.

Australian Field Pea number 1 grade is received by a few buyers who supply premium human consumption markets. This grade requires minimal insect damage and breakages (defectives 3% maximum) and minimal discolouration or staining of grain (1% maximum).

Most deliveries are into Australian Field Pea number 2 grade which requires low insect damage and breakages (defectives 7% maximum) and minimal foreign material or impurities (3% maximum). Discolouration or staining of grain is not a specified rejection in number 2 grade.

<table>
<thead>
<tr>
<th></th>
<th>Maximum moisture content (%)</th>
<th>Minimum purity (%)</th>
<th>Maximum defective plus poor colour (%)</th>
<th>Screen size for defective (mm)</th>
<th>Poor colour maximum (%)</th>
<th>Foreign material maximum in total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No 1 grade receival standard</td>
<td>14</td>
<td>97</td>
<td>3</td>
<td>3.75 slotted</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>No 2 grade receival standard</td>
<td>14</td>
<td>97</td>
<td>7</td>
<td>-</td>
<td>-</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Unmillable material maximum</th>
<th>Snail maximum</th>
<th>Insect maximum</th>
<th>Nominated weed seed maximums</th>
</tr>
</thead>
<tbody>
<tr>
<td>No 1 grade receival standard</td>
<td>0.5 (0.3% soil)</td>
<td>1 per 200 g</td>
<td>15 per 200 g</td>
<td>See footnote for weeds and amounts allowable</td>
</tr>
<tr>
<td>No 2 grade receival standard</td>
<td>0.5 (0.3% soil)</td>
<td>1 per 200 g</td>
<td>15 per 200 g</td>
<td>See footnote for weeds and amounts allowable</td>
</tr>
</tbody>
</table>

Minimise handling field peas to limit physical damage. Belt shifters are preferred. Augers can damage peas, so run the auger full at a slower speed than for cereals. Bunkers, sound sheds and silos are suitable storages. Avoid dropping the peas from great height. Silo bags should only be considered as short term, temporary storage of field peas as discolouration of grain can occur, moisture can be difficult to handle, and bags can be holed by vermin, birds or pests.

Store seed and grain at no more than 13% moisture, unless aeration is used to prevent spoilage. 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 pea weevil is detected, fumigate with phosphine in a sealed silo. This is the only treatment effective against pea weevil. Extra costs will be 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 and mouldy grain are unacceptable. Check regularly for insects or mould.

Air movement in the bin during cold (A) and warm (B) periods.

**Image:** W Hawthorne, Pulse Australia
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*Bold type indicates an image*
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- accessing reliable market signals;
- ensuring rapid adoption of newly released varieties;
- accessing elite germplasm and enabling technologies;
- a proficient and cost effective breeding process; and
- enhancing germplasm, technologies and intellectual property across all states.

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Growers new pulse varieties that have better disease resistance, are higher-yielding and are adapted to Australian conditions.

By sharing germplasm, technologies and intellectual property across all states, PBA delivers to Australian growers new pulse varieties that have better disease resistance, are higher-yielding and are adapted to Australian conditions.

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