Seed Health Testing in Pulse Crops

Note Number: AG1250
Published: May 2008
Updated: June 2011
Reviewed: June 2013

Many important diseases of pulses can be seed-borne. Pulse growers can minimize losses from these diseases by using high quality seed. Seed testing is required to establish whether seed is infected. Seed health tests are currently available to detect the most important seed-borne pathogens of pulses. Only seed that is pathogen-free should be used for sowing. Testing seed before sowing will identify potential disease problems and allow steps to be taken to reduce the disease risk. Laboratory testing is usually required, as infected seed may have no visible disease symptoms.

Importance of seed-borne diseases

Results of seed health tests in Australia and overseas have shown that many serious diseases of pulses can be seed-borne and significant crop losses can result from the use of infected seed. Also the uncontrolled movement of infected seed between regions can result in the rapid expansion of the area affected by these diseases.

Pathogens can adversely affect germination, cause seedling infection and damage mature plants. The transmission of fungal and bacterial pathogens from seed to crop can vary considerably depending on growing conditions. Diseases caused by viruses usually have higher transmission rates than those caused by fungi or bacteria, and are less affected by seasonal conditions. Consequently, there are different tolerance levels for seed infection by different pathogens (Table 1).

Seed-borne diseases often strike early in the growth of a plant causing poor crop establishment and reduced plant vigour which results in lower yields, for example cucumber mosaic virus in lupins. However, some diseases like Ascochyta in chickpea for example, can cause total crop loss.

Symptoms of seed-borne diseases

Viruses

Alfalfa mosaic virus (AMV)
Plants may develop a bright yellow leaf mottle, tip necrosis, reddening, stunting, pod flattening and blackening (Figure 1). Yields are reduced through plant death, the production of small seeds, and seeds with brown coat discoloration. A high incidence of AMV is found in lentil, lupin and chickpeas.

Bean yellow mosaic virus (BYMV)

Plant leaves may develop leaf mottle or a distinctive yellow mosaic pattern, stunting and reduced leaf size. Early infections can seriously reduce plant growth and grain yield (Figure 2). BYMV is an economically important virus for lupins.

Cucumber mosaic virus (CMV)

Plants may develop leaf chlorosis (yellowing), stunting, distortion or bunchy appearance. Pods may be flattened and turn purple-brown (Figure 3). CMV causes problems in lentil, lupin and chickpea.

Pea seed-borne mosaic virus (PSbMV)

Plants may develop downward rolling of leaf margins and slight clearing of the veins in young leaves. Production of small seeds with distinctive brown staining and ‘tennis ball’ marking is common. Seed discoloration can significantly reduce the commercial value of grain (Figure 4). PSbMV is an economically important virus for field peas.

Fungi

Ascochyta blight (Ascochyta fabae, Ascochyta lentis, Ascochyta pisi, Ascochyta rabiei, Mycosphaerella pinodes, Phoma pinodella)

Tan coloured lesions form on leaves, stems and pods. Infected leaves may drop prematurely. Yields are reduced through plant death and crop damage. Infected seed can be shrivelled or badly stained (Figure 5).

Grey mould and chocolate spot (Botrytis cinerea and Botrytis fabae)
Stem infection can cause the damping-off of young seedlings. Later infection causes grey mould or chocolate spot on foliage and flowers. Yields are reduced through plant death, crop damage and flower abortion. Infected seed can be small and badly discoloured (Figure 6).

Lupin anthracnose (*Colletotrichum lupini*)

A severe foliar disease that causes bending and twisting of stems, with a lesion in the crook of the bend (walking stick). Stem infection often results in the death of plants and major yield losses. Affects both narrow leaf lupins and albus lupins. Note: Anthracnose is an exotic disease in Victoria and there are restrictions on seed movement. For more information, see the [Lupin Anthracnose Compliance Agreement](#).

Phomopsis stem blight (*Phomopsis leptostromiformis*)

Causes yellow-brown lesions on leaves stems and pods. Severe infection can kill plants. Infected seed can be covered with a web-like grey mould. Toxin produced by infected stubble can kill animals.

Brown leaf spot (*Pleiochaeta setosa*)

Can cause both root rot and leaf spotting. Affected roots develop large dark brown lesions. Irregularly shaped dark brown lesions develop on infected leaves. Can seriously reduce plant growth and grain yield.

**Fig 4. Field pea seed infected with pea seed-borne mosaic virus (Photo J Davidson SARDI)**

**Fig 5. Lentil seed discolouration caused by Ascochyta lentis**

**Fig 6. Grey mould caused by Botrytis on chickpea seed**

**Bacteria**

Bacterial blight (*Pseudomonas syringae pv pisi* and *Pseudomonas syringae pv syringae*)

Important seed-borne disease of field peas. Both these pathogens may be carried by the seed either internally or externally. Water-soaked leaf, stem and pod lesions may occur at any growth stage. Yields are reduced through plant death, crop damage and the production of small seeds. Brown discolouration of the seed coat can sometimes occur.

**Epidemiology of seed-borne diseases**

**Infection of seed**
Seed infection levels are determined primarily by weather conditions between flowering and maturity. Warm, humid conditions during this period often results in heavy pod and seed infection.

Dry weather between flowering and maturity minimizes pod infection, and is essential for the production of pathogen-free seed.

There is often considerable variation between genotypes in their resistance to seed infection. Virus infection in seed depends on the amount of spread of virus between plants during the growing season, often by aphid vectors, and the genetic susceptibility of the host plant.

Seed to plant transmission

Crop losses are likely to be higher for pathogens that invade the roots soon after germination than for pathogens that affect the shoots of young plants. The extent of 'seed-plant transmission' of fungal and bacterial pathogens is known to vary considerably depending on infection conditions. Poor germination and diseased seedlings can result from the use of infected seed lots.

Transmission from seed to seedling is usually highest for viruses, and varies from around 0.1-5% for AMV/CMV and to up to 100% for PSbMV. Transmission rates for fungal and bacterial pathogens are affected more by the environment, and some diseases can be carried over in soil and/or on crop residues.

Survival on seed

Seed-borne pathogens can often survive for several years in and on seed. Some pathogens are carried on the seed coat while others can be harboured deep inside the seed. Fungi and bacteria are mostly located on the seed coat, and embryo infection is uncommon. Viruses are not carried on the seed coat, and are only found in the seed embryo or tissues of the seed coat.

Infestation levels of most pathogens decrease rapidly during storage, and long-term storage can eliminate some pathogens from seed. Unfortunately, there is likely to be a marked reduction in the viability of seed stored for a long period and this may negate any benefits from lowering disease levels in seed.

Management of seed-borne diseases

Measuring the amount of seed-borne inoculum

The amount of inoculum may be expressed in terms of the proportion of infected seeds, the degree or severity of infection (inoculum per individual seed) or the viability of the inoculum (i.e. the infectivity of the pathogen in seed). Most seed tests measure the proportion of infected seed. Because low levels of seed-borne inoculum can lead to considerable disease, the most sensitive test should be used to determine the level of seed infection.

Fungi may be detected using a standard blotter test or an agar plate test, the latter being the more sensitive. Seed-borne bacteria can also be detected using an agar plate test. While results of standard tests indicate the proportion of infected seed, they provide no information on the amount of inoculum per seed. Where a high
percentage of seed is infected there is often more inoculum per seed associated with larger infections and deeper penetration. Seed-borne viruses are usually detected using ELISA or PCR tests. It is important that the diagnostic tests are conducted on germinated seed (seedlings) as virus may sometimes infect the seed testa without infecting the embryo or seedling e.g. PSbMV.

There is a wide range of tolerance levels for different pathogens. For viral diseases a threshold of <0.1% seed infection is recommended for sowing in high risk areas, and <0.5% seed infection for sowing in low risk areas. For most fungal pathogens a threshold of <1% seed infection is acceptable. However, there is a nil tolerance for the most serious fungal diseases e.g. Ascochyta rabiei in chickpea (Table 1).

Preventing the spread of seed-borne diseases

The best method of to reduce the risk of disease damage is to source pathogen-free seed. Testing seed before sowing will establish whether seed is free of disease (Table 1). The next best option is to select seed from crops that show no sign of disease. Seed with high levels of seed-borne disease should not be used for sowing. For some fungal diseases, it may be possible to reduce the risk of disease by applying a fungicide to seed prior to sowing. However, seed treatments are not available for the control of virus or bacterial diseases.

Producing disease free seed

The best method of to reduce the risk of disease damage is to source pathogen-free seed. Testing seed before sowing will establish whether seed is free of disease (Table 1). The next best option is to select seed from crops that show no sign of disease. Seed with high levels of seed-borne disease should not be used for sowing. For some fungal diseases, it may be possible to reduce the risk of disease by applying a fungicide to seed prior to sowing. However, seed treatments are not available for the control of virus or bacterial diseases.

Table 1. Seed health tests currently available and tolerance levels for seed infection

<table>
<thead>
<tr>
<th>Viruses</th>
<th>Laboratory submitted</th>
<th>Sample size (kg)</th>
<th>Number of seeds tested</th>
<th>Seed infection threshold for acceptance of seedlot (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMV</td>
<td>1,2,5</td>
<td>3</td>
<td>1000</td>
<td>Less than 0.1% Less than 0.5%</td>
</tr>
<tr>
<td>BYMV</td>
<td>2,5</td>
<td>3</td>
<td>1000</td>
<td>Less than 0.1% Less than 0.5%</td>
</tr>
<tr>
<td>CMV</td>
<td>1,2,5</td>
<td>3</td>
<td>1000</td>
<td>Less than 0.1% Less than 0.5%</td>
</tr>
<tr>
<td>PSbMV</td>
<td>2,5</td>
<td>3</td>
<td>1000</td>
<td>Less than 0.1% Less than 0.5%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bacteria</th>
<th>Laboratory submitted</th>
<th>Sample size (kg)</th>
<th>Number of seeds tested</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2,3</td>
<td>1</td>
<td>1000</td>
<td>Nil tolerance Less than 0.1%</td>
</tr>
</tbody>
</table>
### Pseudomonas syringae

**pv pisi**

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>Code</th>
<th>Seed Weight</th>
<th>Seed Rate</th>
<th>Tolerance Level</th>
<th>Threshold</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Pseudomonas syringae</em></td>
<td>2,3</td>
<td>1 kg</td>
<td>1000</td>
<td>Nil tolerance</td>
<td>Less than 0.1 %</td>
</tr>
<tr>
<td><em>pv syringae</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Fungi

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>Code</th>
<th>Seed Weight</th>
<th>Seed Rate</th>
<th>Tolerance Level</th>
<th>Threshold</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Ascochyta and Botrytis</em></td>
<td>1</td>
<td>1 kg</td>
<td>400</td>
<td>Less than 1 %</td>
<td>Less than 5 %</td>
</tr>
<tr>
<td><em>Ascochyta fabae</em></td>
<td>2,4</td>
<td>1 kg</td>
<td>400</td>
<td>Less than 1 %</td>
<td>Less than 5 %</td>
</tr>
<tr>
<td><em>Ascochyta lentis</em></td>
<td>2,4</td>
<td>1 kg</td>
<td>400</td>
<td>Less than 1 %</td>
<td>Less than 5 %</td>
</tr>
<tr>
<td><em>Ascochyta pisi</em></td>
<td>2</td>
<td>1 kg</td>
<td>400</td>
<td>Less than 1 %</td>
<td>Less than 5 %</td>
</tr>
<tr>
<td><em>Ascochyta rabiei</em></td>
<td>2,4</td>
<td>1 kg</td>
<td>1000</td>
<td>Nil tolerance</td>
<td>Nil tolerance</td>
</tr>
<tr>
<td><em>Botrytis cinerea</em></td>
<td>2,4</td>
<td>1 kg</td>
<td>400</td>
<td>Less than 1 %</td>
<td>Less than 5 %</td>
</tr>
<tr>
<td><em>Botrytis fabae</em></td>
<td>2</td>
<td>1 kg</td>
<td>400</td>
<td>Less than 1 %</td>
<td>Less than 5 %</td>
</tr>
<tr>
<td><em>Colletotrichum lupini</em></td>
<td>2</td>
<td>1 kg</td>
<td>1000</td>
<td>Nil tolerance</td>
<td>Nil tolerance</td>
</tr>
<tr>
<td><em>Mycosphaerella pinodes</em></td>
<td>2</td>
<td>1 kg</td>
<td>400</td>
<td>Less than 1 %</td>
<td>Less than 5 %</td>
</tr>
<tr>
<td><em>Phoma pinodella</em></td>
<td>4</td>
<td>1 kg</td>
<td>400</td>
<td>Less than 1 %</td>
<td>Less than 5 %</td>
</tr>
</tbody>
</table>

^Seed testing services: 1. AgriFood, 2. AGWEST, 3. AssureQuality, 4. SARDI, 5. TASAG. BThresholds given are a guide only. Growers should discuss the likely disease risk on their farm with local advisers. Wherever possible, only pathogen-free seed should be used. This is most important when a crop is being grown in a new area. It is important to note that a negative result from a seed test does not guarantee that a seed lot will be free from disease. .

### Seed testing laboratories

1. **AgriFood Technology Box 728, Werribee, Vic 3030. Telephone: 03 9742 0555, Fax: 03 9742 4228.**
2. **AGWEST Plant Laboratories** Department of Agriculture Western Australia, 3 Baron Hay Court, South Perth, WA 6151. Telephone: 08 9368 3721, Fax: 08 9474 2658.
Further References

More detailed information can be obtained from the DEPI Information Notes Series

Pulse Australia: Virus Management in Pulse Crops  Trevor Bray, Southern Pulse Bulletin, Pulse Australia
Pulse Australia: Virus Control & Aphid Monitoring Simplified  Trevor Bray and Wayne Hawthorne, Southern Pulse Bulletin, Pulse Australia
Pulse Australia Chickpea: Sourcing High Quality Seed
Victorian Lupin Anthracnose Compliance Agreement
Victorian Winter Crop Summary

Contact/Services available from DEPI

DEPI Field Crops Pathology, Grains Innovation Park, 110 Natimuk Rd, Horsham 3400. Tel (03) 5362 2111, or the DEPI Customer Service Centre 136 186.

Acknowledgements

This Fact Sheet (AG1250) was developed by Mohammad Aftab, Angela Freeman and Trevor Bretag, DEPI Horsham (2006). It was reviewed by Frank Henry, Farm Services Victoria - BioSciences Research, June 2011. Financial support by the GRDC is gratefully.

ISSN 1329-8062

Published and Authorised by:
Department of Environment and Primary Industries
1 Spring Street
Melbourne, Victoria

This publication is copyright. No part may be reproduced by any process except in accordance with the provisions of the Copyright Act 1968.

The advice provided in this publication is intended as a source of information only. Always read the label before using any of the products mentioned. The State of Victoria and its employees do not guarantee that the publication is without flaw of any kind or is wholly appropriate for your particular
purposes and therefore disclaims all liability for any error, loss or other consequence which may arise from you relying on any information in this publication

For information about DEPI, Phone: 136 186

Deaf, or hearing or speech impaired?
National Relay Service: 133 677
or www.relayservice.com.au

Victorian Bushfire Information Line: 1800 240 667

Following the State Election held on 29 November 2014, there has been a change of Government. The website will be updated accordingly.

Careers Copyright Privacy Disclaimer Accessibility Sitemap

Page last updated: 30 May 2015

© The State of Victoria, 1996-2015