

Mildew diseases of soybean

Background

In Australia, soybeans are affected by two mildew diseases, downy mildew caused by *Peronospora manshurica* (previously known as *Peronospora sojae*) and powdery mildew caused by the *Erysiphe diffusa* (previously known as *Erysiphe polygoni* and *E. glycines*). The powdery mildew diseases of cucurbits, roses, and other common garden and commercial crops are not caused by *Erysiphe diffusa*, but by other powdery mildew fungi.

Soybean downy mildew occurs on average once every 4 or 5 years in the north coast region of New South Wales and less frequently in southern Queensland. It is thought to cause little economic loss in Australia, but overseas losses of up to 10% have been recorded.

By contrast, powdery mildew was rarely seen in commercial crops prior to 2012, but has now been observed in every subsequent season in all soybean growing areas of Australia, albeit only on some varieties. The losses due to powdery mildew have not been determined in Australia, but overseas yield losses of over 25% have been reported on susceptible varieties.



Figure 1: Powdery mildew

Left; susceptible variety.

Right; resistant variety.

Photo: H Brier, Qld DAFF

Biology and epidemiology

Downy mildew; is reported to survive between soybean crops in infected seeds, as oospores in soil and stubble, on soybean volunteers or on plants of other legumes including *Glycine tomentella*.

Initial crop infection by the downy mildew pathogen occurs when;

- (i) infected seeds germinate resulting in systemically-infected seedlings,
- (ii) oospores germinate and the resulting fungal strands invade seedlings, or
- (iii) airborne spores from soybean volunteers or alternative hosts are deposited on leaf surfaces.

There the spores germinate rapidly when there is a layer of free water from rain, irrigation or dew and the fungal threads grow into the leaves.

During periods of cool humid weather the spore-bearing structures (conidiophores) grow through leaf pores (stomates) into the air where they become dichotomously branched (tree-like) as they mature. The spores (conidia) are produced singly at the tips of the branches. Further in-crop infection of leaves and pods results after the spores are dispersed during windy weather.

As infected plants mature resting spores (oospores) develop in the leaf under the spots, on the inside of infected pods, and on seeds in these pods

Powdery Mildew; In Australia nothing is known about the survival of the powdery mildew pathogen, but volunteer soybean plants and perhaps unknown alternative hosts are the likely modes of survival because as a group, the powdery mildew fungi are not seed- or stubble-borne.

Initial infection by the powdery mildew pathogen probably results from airborne spores which originate on volunteer soybean plants or on alternative hosts.

The spores which are deposited on the surfaces of leaves, stems and pods do not require free water for germination; in fact spore germination is inhibited when the plant surfaces are wet. During periods of high humidity the spores germinate and the resulting fungal strands grow across the surface of the plant part. Conidiophores grow from the fungal strands, perpendicular to the leaf surface. These spore-bearing structures are unbranched at maturity, with conidia being produced at their tips.

Powdery mildew can develop rapidly in a crop, as the time from infection to production of conidia can be as short as 7 days, with many millions of the airborne conidia being produced on a single leaf. It is not known if the powdery mildew pathogen in Australia produces specialised survival structures (cleistothecia).

Symptoms

Downy mildew; infection usually appear during and after prolonged periods of cool, wet weather, so the disease is more common late in the growing season and in cooler- and wetter- than normal summers. Soybean plants growing over the winter months for seed increase or in breeder nurseries are also prone to infection.

Pale green to light yellow irregular spots appear on the upper surfaces of young expanding leaves and often enlarge into yellow lesions of variable size and shape as the leaves age. On the lower leaf surface opposite the discolored spots a tuft of grey to pale purple down consisting of the spore-bearing structures (conidiophores) and spores (conidia) appears during humid weather.



Figure 2: Downy mildew

Left; spots on upper leaf surfaces.

Right; close up of down, consisting of spore-bearing structures (conidiophores) and spores (conidia).

Photo: Dr M Ryley

When infection is severe, leaves turn entirely yellow then brown and drop prematurely. Fully expanded leaves are less susceptible to infection than younger leaves.

Pods often do not display any symptoms of infection, but the interior of pods and the seeds may be coated with a white mass consisting of fungal threads and the resting spores (oospores) of the pathogen. Infected seeds are often cracked and smaller than normal seeds.

Powdery mildew; develops over a much wider range of weather conditions and although favoured by cooler than normal weather there is no requirement for prolonged rainfall for outbreaks of the disease.

White powdery patches, beginning as small isolated areas, appear on both surfaces of leaves, and on petioles, stems and pods. The patches usually expand rapidly to cover the entire plant part if the weather conditions are favourable.

The powdery patches consist of fungal threads which run across the plant surface, on which conidiophores bearing conidia develop. Powdery mildew develops first on the lower parts of plants, spreading up the plant over time. Under some circumstances, such as soybeans grown during the winter months in north Queensland, both powdery mildew and downy mildew can occur together on the same leaves.



Figure 3: Powdery mildew

Left; early crop infection.

Photo: N Moore, NSW DPI

Right; close up of advanced infection.

Photo: H Brier, Qld DAFF

Table 1.

Comparison of various features of the downy mildew and powdery mildew diseases of soybean in Australia

Feature	Downy mildew	Powdery mildew
Pathogen	<i>Peronospora manshurica</i>	<i>Erysiphe diffusa</i>
Symptoms	discrete spots on leaves	white areas on all plant parts
Conidiophores*	tree-like, on lower leaf surface	unbranched, on all surfaces
Conidium [#] development	singly at tips of branches	singly at tip of conidiophore
Survival	volunteers and other hosts, oospores on/in infected seed, stubble, soil	volunteers, other hosts
Spread	airborne spores, infected seed, infected stubble	airborne spores
Favoured by	cool, wet weather	humid weather
Management - rotation	yes	no
Management – variety	yes	yes
Management - seed	yes	no
Management- volunteers	yes	yes
Management – other hosts	yes	?
Management- fungicides	no	yes
Management - stubble	yes	no

* spore-bearing structures

spore

**Figure 4:**

Dual infection of downy mildew (yellow spots) and powdery mildew (white growth) on a single soybean leaf.

Photo: M Hanks, Qld DAFF

Management options

Management of both mildew diseases is reliant on the integrated use of a range of options. As downy mildew occurs infrequently and yield losses are generally low, management practices are designed to minimize its impact. On the other hand powdery mildew occurs every year, can develop rapidly and causes significant losses.

- **Paddock selection and rotations** - the downy mildew pathogen has been reported overseas to survive as resistant oospores in soil and infected plant residues, so avoid paddocks where downy mildew has been a problem in the past 2 seasons.
Rotations with other crops in a paddock where powdery mildew was present will not reduce future outbreaks of the disease
- **Varietal selection** - soybean varieties vary in their resistance to both mildew diseases, so chose a variety for your region which has high levels of resistance, particularly to powdery mildew.
Contact your local State Government Department of Agriculture office or agronomist for varietal recommendations

- **Planting seed** - do not use seed which displays the signs of downy mildew infection or which has been harvested from a known downy mildew-infected crop.
The powdery mildew pathogen is not seedborne
- **Volunteer and alternative host control** - for both mildew diseases control volunteer soybean plants and known alternative hosts between growing seasons
- **Fungicides** - no in-crop foliar fungicides are registered for the management of downy mildew.
Consult the APVMA website for products currently under permit for powdery mildew management (i.e. tebuconazole).
- **Stubble management** - practices such as ploughing and slashing can assist in the breakdown of downy mildew-infected plant residue. But the impact of such practices on the survival of oospores of the downy mildew pathogen is unknown.
The powdery mildew pathogen does not survive in stubble.

For additional information contact

Dr Joe Kochman – Soy Australia, Field Officer

ph: 0408 736 356

email: soyfieldofficer@australianoilseeds.com

Gordon Cumming – Pulse Australia, National Manager

ph: 0408 923 474

email: gordon@pulseaus.com.au

Tim Weaver – Pulse Australia, NSW Manager

ph: 0427 255 086

email: timw@pusleaus.com.au

Sue Thompson – USQ, Research Fellow

ph: 0477 718 593

email: sue.thompson@usq.edu.au

Dr Natalie Moore – NSW DPI, Research Agronomist

ph: 02 6640 1637

email: natalie.moore@dpi.nsw.gov.au

Mike Hanks – Qld DAFF, Principal Scientist

ph: 0428 104 685

email: michael.hanks@daff.qld.gov.au

Further reading

Mungbean and Soybean Disorders: The Ute Guide. The Grains Research & Development Corporation, Queensland Department of Primary Industries.

Compendium of Soybean Diseases, 4th edition (eds GL Hartman, JB Sinclair, JC Rupe). The American Phytopathological Society, St Paul MN, USA.

Author: Dr M J Ryley, former Principal Plant Pathologist Qld DAFF

DISCLAIMER – This document has been prepared in good faith on the basis of information available at the date of publication but its accuracy and completeness cannot be guaranteed. No liability or responsibility is accepted for any errors or any negligence, omissions in the content, default or lack of care, or for any loss or damage whatsoever that may arise from actions based on any material contained in this publication. Readers who act on this information do so at their own risk and should obtain specific, independent professional advice. Products may be identified by proprietary or trade name to help readers identify particular types of products but this is not, and is not intended to be, an endorsement or recommendation of any product or manufacturer referred to.

In collaboration with



Queensland
Government



Department of
Primary Industries

