

Phytophthora root and stem rot of soybeans

Background

Phytophthora root and stem rot of soybeans (PRR) is caused by the fungus *Phytophthora sojae* (previously named *Phytophthora megasperma* f.sp. *sojae*), which was first recorded in Australia from the Darling Downs region in 1979. Since then it has been found in all major soybean production areas of Australia.

Although the disease caused significant yield losses in the varieties that were grown in the seasons following the first detection, the incidence and severity of the disease has diminished in recent years.



Figure 1: Soybean plants killed by *Phytophthora sojae* in a low lying area of a field.

Photo: Dr M Ryley

Biology and epidemiology

Phytophthora sojae survives between growing seasons in soil and residues of infected soybean plants as thick-walled structures called oospores, which can remain viable for many years.

During periods of high soil moisture when there is free water, exudates which leach from the roots of soybean plants of a susceptible variety stimulate nearby oospores to germinate and produce lemon-shaped sporangia. Inside each sporangium a large number of zoospores develop and soon after the sporangia mature these zoospores are released and swim towards the roots. There they encyst and the fungal strands grow through the roots and later into the stems. Oospores develop in abundant numbers in infected roots.

The fungus is specific to soybeans and it has no other known hosts in Australia, nor has it been reported to be seedborne. However, oospores and sporangia can spread in irrigation and flood water and in contaminated soil on machinery, vehicles, boots and other equipment.

Five races (strains, pathotypes) of *P. sojae* have been identified in commercial crops in Australia, with races 1 and 15 being dominant in Queensland and northern NSW and races 25 and 53 dominating in southern Australia. Overseas, over 70 races of *P. sojae* have been identified.

Resistance to races of *P. sojae* has been a key breeding target of soybean breeding in Australia, and current commercial varieties have good levels of resistance to the dominant races in each region.

Another species of *Phytophthora*, *P. macrochlamydospora*, has been found in commercial soybean crops only in the coastal growing areas of northern New South Wales. It causes a root rot and an internal discoloration of stems without the presence of the typical external stem lesion typical of those caused by *P. sojae*.

Local indigenous legumes are susceptible to the pathogen so it appears that this fungus is native to Australia. The disease generally appears after a crop has been waterlogged or flooded.



There is no known resistance to *P. macrochlamydospora*

Figure 2: Dark stem lesion caused by *Phytophthora sojae*.

Photo: Dr M Ryley

Symptoms

Phytophthora sojae attacks soybean plants at all stages of growth, causing damping-off of seedlings and wilting and death of older plants. Diseased plants usually occur in patches in poorly drained areas of the paddock and at the tail ditch end of irrigated crops but later infected plants may be found scattered throughout the field.

Outbreaks of PRR are more common in soils with high clay content (e.g. self-cracking clays common in many parts of southern Queensland and northern New South Wales) than in lighter soils. Seedlings infected by *P. sojae* may fail to emerge (pre-emergence damping-off) or rot soon after emergence (post-emergence damping-off). Symptoms of *Phytophthora* infection in the seedling stage are almost identical to those caused by other pathogens, particularly species of *Pythium*.

On older plants the first symptoms are wilting and interveinal chlorosis (yellowing) of the lower leaves. However, the diagnostic feature of PRR is a sunken, brown-reddish lesion advancing up the stem, with a distinct margin between the lesion and the green, healthy part of the stem. The lateral and branch roots on infected plants are almost completely destroyed and infested taproots turn dark-brown. Such plants usually die, with withered leaves remaining on the plant for a week or more.



Figures 4: Close up of stem lesions caused by *Phytophthora sojae* the cause of phytophthora root and stem rot.

Photos: Dr M Ryley



Figures 3: Internal soybean stem discoloration caused by *Phytophthora macrochlamydospora*

Photo: G Stovold

Symptoms of PRR on maturing soybean plants can be confused with those caused by the charcoal rot pathogen, *Macrophomina phaseolina*, but careful observation can separate the two. On stems of *Phytophthora*-infected plants there is a distinct margin between the discolored dark-brown lesion and the healthy, green stem, while on plants infected by *M. phaseolina* there is no such distinctive margin, with a gradation from dark brown to yellow then to light green.



Figures 5: Close up of stem lesions caused by *Macrophomina phaseolina* the cause of charcoal rot.

Photos: L Gaynor, NSW DPI

Management options

Once *Phytophthora* has been found in a soybean crop it is impossible to manage, because there are no effective registered fungicides to eradicate or control the disease.

Consequently, effective management relies on pre-plant practices which will minimise the risk of infection.

These practices are;

- **Paddock selection** - avoid paddocks where *Phytophthora sojae* has been identified in the previous 4 years and paddocks which are poorly drained
- **Crop rotation** - practice good crop rotation to reduce the numbers of viable oospores of *P. sojae*
- **Planting seed** - sow only high germination and vigour seed to ensure rapid germination and emergence; although a metalaxyl-based fungicide is registered as a seed dressing to manage *Phytophthora* it is seldom used due to its expense
- **Irrigation** - ensure that fields drain rapidly to avoid waterlogged conditions
- **Varietal selection** - select a variety suited to your region and which has the highest possible levels of *Phytophthora* resistance
- **Farm hygiene** - minimise the movement of soil in irrigation and overland water and on machinery, vehicles, boots etc. on your farm and ensure that equipment which enters your property is clean of soil and residues.

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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.

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