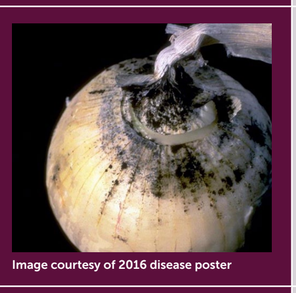
THE ONION PROJECT – SOILBORNE DISEASES

SOILBORNE DISEASE		GERMINATION/ EMERGENCE	CROP ESTABLISHMENT TO BULB INITIATION	BULB MATURATION	MANAGEMENT APPROACHES
FUNGI					
DAMPING OFF *Fusarium, Pythium, and/or Rhizoctonia solani (teleomorph: Thanatephorus cucumeris), often as disease complex*	 Image courtesy of 2016 disease poster.	**SYMPTOMS:** Wilting or death of seedlings at and after emergence leading to bare patches. Seedlings that do emerge may have yellow to light brown discolouration around the base of the stem. Significant stunting of root systems may be evident. **CONDITIONS:** Cool temperatures of 5°C – 15°C, moist and compacted soil are ideal conditions for infection.			**Crop rotation** with non-host cash, cover and biofumigation crops. Balanced nutrition programs based on nutrient budgets and monitoring. Do not over irrigate during flag leaf and first true leaf stage. **Improve soil drainage** by reducing tillage, using raised beds and avoiding excessive irrigation. Precision Ag tools (drainage plans based on elevation) may be used to improve overall paddock drainage.
ONION STUNT *Rhizoctonia solani AG 8, potentially also caused by AG2.1, 3 and 4*	 Image courtesy of South Australian Research Development Institute (SARDI)	**SYMPTOMS:** Circular to irregular patches in the crop varying in size from 1m to 25m in diameter with distinct difference between stunted and healthy plants. Seeds may rot before germinating and seedlings may decay before emergence. Most obvious 6-12 weeks after sowing. Diseased plants may be less than 60 per cent the size of healthy plants. **CONDITIONS:** Soil temperatures less than 15°C and high *R. solani* inoculum level assist disease development.			*Rhizoctonia solani* AG8 is a significant soilborne pathogen of cereal roots in semi-arid Mediterranean regions of Australia. Onion stunting by the same pathogen causes major economic loss in South Australia. **Avoid following cereals with onions** in these areas. **Avoid potatoes** in the rotation. **Use of brassicas or legume cover crops** can reduce or prevent buildup of the pathogen. Soil DNA testing (Predict B or Pt) can identify *R. solani* AG8 and other AG groups. Tillage on the top soil can break up the mycelium of the pathogen. However, frequent tillage will affect soil structure and drainage negatively, and foster soilborne diseases in general.
WHITE ROT *Sclerotium cepivorum, synonym Athelia rolfsii*	 Image courtesy of 2018 disease poster	**SYMPTOMS:** Brown to black rot of the stem near the soil line. As the disease progresses, white fluffy fungal growth will appear at the base of the stem, as well as poppy seed sized black survival structures (sclerotia = long lived resting bodies). Initial yellowing and dieback of leaf tip occurs, later foliage will wilt. Roots also rot, and the plant can be pulled from the ground easily. **CONDITIONS:** Disease development is favoured by cool, moist soil conditions. The soil temperature range for infection is 10°C – 24°C, with an optimum of 15 – 18°C. At soil temperatures above 25.5°C, the disease is markedly inhibited. Soil moisture conditions that are favourable for onion growth are also ideal for white rot development.			**Hygiene measures** are vital to avoid spreading the disease with soil between paddocks. As few as one sclerotium per 10 kilograms of soil can initiate disease. Sclerotia survive 20-30 years in the soil. Paddocks considered to be at risk of having onion white rot are best planted later in the season when temperatures are higher, or not at all. Fungicide applications should generally target the top 100mm of soil.
PINK ROOT *Phoma terrestris syn. Pyrenochaeta terrestris*	 Image courtesy of 2016 disease poster		**SYMPTOMS:** Roots show light pink colour that becomes deeper pink/ purple/brown as they shrivel and disintegrate. Leaves wilt, turning white, yellow or brown at tip and eventually die. Some *Fusarium* species can also cause pink roots, particularly on dead or old roots. Field diagnosis of pink root can only be accurately accomplished by observing pink roots on actively growing plants. **CONDITIONS:** Occurs in ground with poor rotations and becomes more destructive over time. Wounds are not necessary for infection, and weak plants are more susceptible. Optimum temperatures for growth of the pathogen and disease development are 24°C – 28°C. It can persist in soil indefinitely and may spread via water or dirty equipment.	**Long term rotation (4-6 years)** with non-host crops. Planting onions after cereals or sweet corn can increase the risk of this disease because the inoculum potential generally becomes greater with these crops. Use resistant varieties if possible that 'work' in the region. **Maintain good soil structure and drainage** as well as fertility via balanced nutrition programs and monitoring. **Control insects** and other diseases to maintain healthy plants.
BLACK MOULD *Aspergillus niger*	 Image courtesy of 2016 disease poster		**SYMPTOMS:** Black discoloured areas on neck of bulb with small black spore masses. **CONDITIONS:** Most common when temperatures are higher than 30°C in the field or 24°C in storage. Spores of this fungus are very common in the air and soil.	**Monitor established crops**. Withdraw irrigation 21 days before harvesting, if crops are affected. Storage conditions should be cool and dry; bruising or other mechanical damage of bulbs should be avoided. Avoid storing crops that have already shown symptoms in the field.
FUSARIUM BASAL ROT *Fusarium oxysporum f. sp. Cepae*	 Image courtesy of 2016 disease poster		**SYMPTOMS:** Pinkish, brown rot that becomes covered with a whitish, fluffy fungal growth. Leaf tips yellow, entire leaves wilt. **CONDITIONS:** Most common in warm temperatures above 25°C. Infection is limited below 15°C. Infections occur when soil moisture is high and especially when there is physical crop damage e.g. mechanical, herbicide, fertiliser or insect damage.	**Crop rotation with cereal crops (if there is no risk of *Rhizoctonia* or *Phoma* infections)/cover crops**; biofumigation crops. Balanced nutrition programs based on nutrient budgets and monitoring. Improve soil drainage by reducing tillage, use raised beds and regulate soil moisture by avoiding excessive irrigation. Precision Ag tools (drainage plans based on elevation) may be used to improve overall paddock drainage.
NEMATODES					
BULB EELWORM *Ditylenchus dipsaci*	 Image courtesy of Getty Images, 2019	**SYMPTOMS:** The base of infected seedlings are stunted, pale, have swollen areas along the cotyledons and may appear split. Twisted and malformed leaves, with slightly raised yellowish-brown spots, can be short and thickened and stem swelling (bloating) can occur. **CONDITIONS:** Optimum soil temperature of 20°C – 22°C for nematode movement and symptom development, while free moisture favours nematode longevity and activity.			**Good on-farm hygiene**, minimum 3-year break in onion cropping and consider pre-plant soil DNA testing to identify risks. **Improve soil health** by adding organic matter, and **improve soil structure** by reducing tillage and using biofumigation crops. **Improve drainage** using raised beds, Precision ag tools and by avoiding excessive irrigation.
ROOT KNOT NEMATODE *Meloidogyne spp.*	 Knot in the onion root as a result of the nematode. Image courtesy of the 2017 disease poster	**SYMPTOMS:** Small, swollen galls (1-2 mm) can be found on the roots. The shape of the galls can be round or spindly, and with or without short root branches that rise from the upper part of galls. White to dark brown egg masses on the surface of the roots may occur. Above ground symptoms may include stunting and yellowing and poor or irregular plant stands. **CONDITIONS:** Damage is more severe in sandy soils than in clay soils.			**Biofumigation**, crop rotation to a non-host or a long fallow period helps to reduce populations of root knot nematodes. Fallow periods, however, lead to carbon loss.

COMMENTS:

- *Consider growing a biofumigant crop.*
- *Minimise tillage. Try to avoid root damage during cultivation.*
- *Consider a pre-plant DNA test to identify disease risks. Obtain seed from a reputable source; conduct seed health tests. Consider moving planting time depending on disease risks.*
- *Good soil calcium levels and calcium supplements used early may help reduce the impact of diseases.*
- *Ensure good irrigation, drainage and nutrition management – monitor crop and soil.*
- *Avoid plant stress as a result of soil compaction, unbalanced nutrition, herbicide damage and soil moisture extremes.*

- *Increase irrigation according to water demand at this stage of the crop.*
- *Conduct soil and plant tests to monitor fertility and crop nutrition.*
- *Monitor soil moisture and nutrient uptake.*
- *Nitrate fertilisers are a better option than ammonium fertilisers, do not overuse nitrogen especially close to and after bulbing. Balanced nutrition and adequate calcium supply are essential.*
- *Screen field regularly for pests and diseases. Consider using remote imaging via satellites or drones to identify problem areas in the crop.*

- *Cease irrigations seven days prior to harvest.*
- *Check available soil nitrate levels in the soil. They should be below 50 kg/ha to 30 cm depth. If higher than that there is an increased risk of postharvest breakdown e.g. bacterial soft rot and skinning.*

- *Stop the movement of contaminated crop inputs, vehicles, equipment and water between paddocks and farms.*
- *Farm hygiene and biosecurity measures are key. Refer to https://www.farmbiosecurity.com.au/wp-content/uploads/2019/03/Biosecurity-Manual-for-Onion-Growers*
- *Microbial biocontrols may be of use, check that their benefit is proven; consider adding organic matter to improve soil health refer to www.soilwealth.com.au*
- *Rotate to non-allium crops for four years if disease is present and avoid host crops and weeds.*
- *Ask a diagnostician to confirm the pathogen type if issues are detected.*

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