SoilWealth NURTURING CROPS

Integrated Crop Protection PROTECTING CROPS

DECEMBER 2020

BETTER MANAGING SOILBORNE DISEASES WITH PATHOGEN DNA TESTING

KEY MESSAGES

✔ **This fact sheet provides guidance on the importance of monitoring soilborne diseases, pathogens that can be tested, method for pathogen testing and tips for understanding and managing soilborne disease risks.**

✔ **Pre-planting soilborne disease assessment is critical to make informed decisions, implement cost-effective disease control strategies and reduce potential losses.**

✔ **Crop loss from soilborne disease can be substantial. Soilborne diseases can cause crop failure resulting in substantial financial loss as well as failure to supply the market.**

✔ **Knowing the level of risk and being able to monitor changes in this risk through cropping cycles provides the greatest opportunity to manage soilborne diseases successfully.**

✔ **The cost of crop losses due to soilborne diseases is far greater than the cost of testing.**

WHY IS MONITORING SOILBORNE DISEASES IMPORTANT?

Pre-plant soil DNA testing allows growers to optimise paddock management to avoid or minimise current and future productivity losses. Knowing which pathogen(s) pose a risk means that control measures can be targeted and effective.

Soilborne diseases can have a serious impact on vegetable quality and yield. Productivity losses can occur through:

- Lower field yield and/or reduced packout
- Limited water and nutrient uptake
- Increased input requirements
- Increased risk of insect damage
- Increased weed seed set through reduced crop competition
- Increased crop damage from some herbicides
- Reduced cropping options.

The pathogens that cause soilborne diseases survive in the soil, waiting to infect the root system of vegetable crops. For some pathogens, the quantity of inoculum in the soil is strongly related to the risk of disease occurring.

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WHAT PATHOGENS CAN YOU TEST FOR?

The current suite of tests available for vegetable growers (Hort Veg) is most suited to use in brassica, carrot, capsicum, sweet potato and onion production. While testing can support other vegetable crops, the applications can be more limited and is dependent on the diseases present in the soil. A separate testing service is available for potatoes (PREDICTA® Pt).

Assays included in the Hort Veg soilborne disease assessment panel for vegetables to quantify pathogen DNA levels in soil and plant samples are outlined in the table below.

DNA Assay	Reported units	Target disease	Target crops
Pathogen			
Aphanomyces euteiches	pg DNA / g	Aphanomyces root rot	Beans, peas
Colletotrichum coccodes	pg DNA / g	Anthracnose	Solanaceous vegetables
Macrophominia phaseolina	kcopies DNA / g	Charcoal rot	Beans, brassicas, capsicum, carrots, melons, peas, sweet potato
Plasmodiophora brassicae	kcopies DNA / g	Clubroot	Brassicas
Leptosphaeria maculans	pg DNA / g	Black leg	Brassicas
Pythium sulcatum	kcopies DNA / g	Cavity spot	Carrots
Pythium violae	kcopies DNA / g	Cavity spot	Carrots
Pythium clade F	pg DNA / g	Pythium	Vegetables
Pythium clade I	pg DNA / g	Pythium	Vegetables
Rhizoctonia solani AG 2.1	pg DNA / g	Wirestem	Brassicas, potatoes
Rhizoctonia solani AG 2.2	pg DNA / g	Rhizoctonia	Carrots, sweet corn
Rhizoctonia solani AG 3	pg DNA / g	Rhizoctonia	Solanaceous vegetables (potatoes, eggplants, tomatoes)
Rhizoctonia solani AG 4	pg DNA / g	Rhizoctonia	Brassicas, cucurbits, sweet corn
Rhizoctonia solani AG 8	pg DNA / g	Onion stunt	Onions
Sclerotinia sclerotiorum/minor	kcopies DNA / g	Sclerotinia rot	Beans, brassicas, carrots, celery, peas, lettuce, potatoes
Setophoma terrestris	kcopies DNA / g	Pink/Red root rot	Onions, sweet corn, sweet potatoes, strawberries
Thielaviopsis basicola	kcopies DNA / g	Black root rot	Beans, carrots, lettuce, cucurbits
Verticillium dahliae	pg DNA / g	Verticillium	Solanaceous vegetables, brassicas, lettuce, strawberries
Streptomyces txtA gene	pg DNA / g	Scab	Potatoes, carrots
Nematodes			
Meloidogyne hapla	pg DNA / g	Root knot nematode	Vegetables, potatoes
Meloidogyne fallax	pg DNA / g	Root knot nematode	Vegetables, potatoes
M. javanica/incognita/arenaria	pg DNA / g	Root knot nematode	Vegetables
Pratylenchus crenatus	nematodes / g	Root lesion nematode	Carrots
Pratylenchus neglectus	nematodes / g	Root lesion nematode	Vegetables
Pratylenchus penetrans	nematodes / g	Root lesion nematode	Vegetables
Pratylenchus thornei	nematodes / g	Root lesion nematode	Carrots
Pratylenchus zeae	kcopies DNA / g	Root lesion nematode	Sweet corn

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HOW CAN YOU TEST FOR PATHOGENS?

The SARDI Molecular Diagnostic Centre has developed PREDICTA®, a DNA-based soil testing technology that can accurately quantify the level of DNA of specific disease causing pathogens in a sample of soil. The testing service allows growers to identify which soilborne pathogens pose a significant risk to their crops so steps can be taken to minimise production losses.

PREDICTA® testing can:

- Detect low levels of specific pathogens in soil (or other sample types)
- Quantify specific pathogens in a sample
- Test multiple pathogens on the same sample
- Deliver sample results relatively quickly, compared to traditional inoculum measurement techniques
- Quantify pathogen levels both prior to planting and at any stage of the cropping cycle.

Further information on how PREDICTA® can support your crop monitoring and management decisions is available at: https://www.horticulture.com.au/globalassets/hort-innovation/resource-assets/vg15009-sardi-veg-predicta-manual.pdf.

PREDICTA® soil DNA testing in field. Image courtesy of SARDI.

Cavity spot symptoms on carrots caused by *Pythium sulcatum*. Image courtesy of SARDI.

TIPS FOR UNDERSTANDING AND MANAGING SOILBORNE DISEASE RISKS

To better understand soilborne disease risk you can:

1. Undertake pre-plant soil DNA tests, seed testing and use healthy transplants
2. Know the crop histories and monitoring of diseases in previous crops to guide site selection and crop choices
3. Use weather monitoring and disease forecasting to help manage risks identified by soil and seed tests and target pesticide applications
4. Recognise the relationship between soilborne disease, soil conditions and soil health management.

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In order to better manage soilborne disease risk you can use the table below to inform your decision making.

Component	Management option
Site selection	• Select site according to test results and knowledge of paddock conditions/history
Crop selection	• Use tolerant or resistant cultivars
Crop management	• Select optimal planting times (especially for susceptible varieties and/or 'risky' paddocks) • Refine cropping system according to pathogen inoculum, chemistry and soil health test results • Rotate crop as much as possible, and with non-hosts • Use biofumigation/cover crops but avoid soilborne disease hosts (however, some reports have shown benefits of brassica cover crops and faba beans to control *Sclerotinia*, for example) • Undertake good weed control, including hosts
Hygiene and sanitation	• Maintain good hygiene and sanitation, and minimise soil, water and equipment movement from infested fields to clean sites • Remove infected plants early, if possible
Soil and water management	• Ensure soil health management, especially biological diversity and soil structure (minimum tillage, controlled traffic) and suitable organic amendments (suppressive soils) • Provide good overall nutrient/fertility management, and avoid excess nitrogen • Undertake soil moisture management via irrigation scheduling and monitoring • Enable good drainage (surface drainage and good soil structure)
Chemical control	• Optimise fungicide types, application methods and timing, and manage pesticide resistance • Consider fumigation for protected and high value crops (e.g. seed), however fumigation should be a last resort and requires reintroduction of beneficial soil life (e.g. via compost)

For all damping off fungi (e.g. *Pythium* spp., *Fusarium* spp., *Rhizoctonia* spp.) additional risk management approaches include:

- Use "clean" seed and transplants, grown with good nursery practices
- Minimise plant stress through good overall crop management
- Monitor your water source (especially for hydroponic crops) to ensure water does not spread pathogens
- Support quick emergence from soil and good early root growth.

Crop failure of brassicas caused by clubroot. Image courtesy of SARDI.

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