Testing for soilborne pathogens

BRASSICA - CARROT - CAPSICUM - SWEET POTATO - ONION

PREDICTA
DNA Soilborne disease tests

How PREDICTA® can support your crop monitoring and management decisions

Hort Innovation

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SARDI
SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

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Disclaimer
The information in this manual is only intended to be general background technical information to support the awareness of **PREDICTA®** testing in the vegetable industry. It is not intended to be exhaustive and readers may need to refer to other technical literature and information and/or seek independent professional advice.

While the authors have made every effort to ensure the information contained within is accurate and up to date at the time of preparation, they do not make any representation or give any warranty as to the accuracy, currency, reliability or completeness of the information.

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Overview

Soilborne diseases are a major limiting factor for the Australian vegetable industry and are costly and difficult to manage. Previous research has highlighted that practical and economic methods of disease control are limited once a crop has been established. Knowing the disease risk prior to planting allows growers to make informed crop management decisions.

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.

The current suite of tests available for vegetable growers 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. The SARDI Molecular Diagnostic Centre support team is available to answer any questions on the application and potential of testing.

Know before you plant

- 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.

Soilborne pathogens and diseases

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 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.

Definitions

PATHOGEN – organism (e.g. plant parasitic fungus, bacteria or nematode) that infects plant to cause disease

INOCULUM – parts of pathogen that reside in the soil and can infect plants

DISEASE – expression of symptoms that negatively affect yield and/or quality of vegetable crop (i.e. symptoms caused by the pathogen)

Did you know?

There are four main factors that determine the development of each soilborne disease.

- Pathogen level
- The crop or variety grown
- On-farm management practices, and
- The environment.

The grower has the ability to vary agronomic practices, but unfortunately, they have less control on the environment.

PREDICTA® fast facts

Did you know 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

PREDICTA® allows growers and advisers to:

- ✓ Conduct pre-plant assessments of disease risk
- ✓ Conduct in-crop testing of soil or plant samples
- ✓ Monitor and understand pathogen level changes in cropping systems
- ✓ Evaluate management practices and their effect on pathogen inoculum levels
- ✓ Investigate causes of disease
- ✓ Select on-farm trial sites
- ✓ Improve outcomes and knowledge gain from on-farm trials
- ✓ Implement better management decisions, such as crop type and variety selection
- ✓ Minimise losses from soilborne disease

PREDICTA® pathogen testing

Growers can now use PREDICTA® to understand pathogen levels.

PREDICTA® testing can provide an indication of the risk or probability of some soilborne diseases occurring. This is possible for pathogens where the inoculum level in the soil – measured as the concentration of DNA by PREDICTA® – is strongly linked to the likelihood of disease occurring. Higher levels of DNA indicate higher levels of disease risk.

PREDICTA® test results can tell a grower which diseases are of greatest concern, allowing a suitable management plan to be implemented which considers variety choice, rotations, chemical management or whether or not to even plant a crop.

Testing allows growers to optimise paddock management to minimise current and future productivity losses.

Pathogen DNA tests available

SARDI offers growers a diverse range of pathogen DNA tests (TABLE 1).

TABLE 1: Pathogen DNA tests included in the vegetable testing suite offered by SARDI.

	Pathogen	Disease
Fungi	*Rhizoctonia solani* (AG2.1)	Rhizoctonia
	Rhizoctonia solani (AG2.2)	
	Rhizoctonia solani (AG3)	
	Rhizoctonia solani (AG4)	
	Rhizoctonia solani (AG8)	
	Verticillium dahliae	Verticillium wilt
	Leptosphaeria maculans	Blackleg
	Colletotrichum coccodes	Black dot
	Setophoma terrestris	Pink root
	Macrophomina phaseolina	Charcoal rot
	Sclerotinia sclerotiorum, *S. minor*	Sclerotinia rot
	Thielaviopsis basicola	Black root rot
Oomycetes	*Aphanomyces euteiches*	Aphanomyces root rot
	Pythium sulcatum	Cavity spot
	Pythium violae	
	Pythium (clade F)	Pythium (damping off)
	Pythium (clade I)	
Nematodes	*Meloidogyne fallax*	Root knot nematodes
	Meloidogyne hapla	
	Meloidogyne arenaria, *M. incognita*, *M. javanica*	
	Pratylenchus crenatus	Root lesion nematodes
	Pratylenchus neglectus	
	Pratylenchus penetrans	
	Pratylenchus thornei	
	Pratylenchus zeae	
Bacteria	*Streptomyces* txtA gene	Scab
Phytomyxea	*Plasmodiophora brassicae*	Clubroot

List is subject to change – for updated list and other available pathogen DNA tests
https://pir.sa.gov.au/research/services/molecular_diagnostics/predicta_research

New PREDICTA® tests only become available after a process of test design and verification

Additional tests available

Soil health

PREDICTA® technology can quantify the level of Free Living Nematodes (FLN) in the soil that can be used to monitor soil health.

Beneficials

PREDICTA® technology can quantify the levels of Arbuscular Mycorrhiza Fungi (AMF) and *Trichoderma* which can be beneficial to some vegetable crops.

Types of samples that can be tested

Soil

Soil is the most common sample type tested by PREDICTA®.

Soil samples weighing up to 500 grams (dry weight) can be tested.

Potting mixes and growth media have high levels of organic matter and require special processing techniques. Therefore, please notify the laboratory prior to testing if these types of samples are submitted.

Plant tissue

- Specialist testing of plant tissue samples is available.
- Testing can include plant root systems, plant stem sections and peels.

Discuss options, sample preparation and handling with the laboratory before sampling.

Sampling for PREDICTA® testing

Correct sampling is critical to obtaining meaningful results from PREDICTA® soil DNA testing.

Pathogens are not evenly distributed throughout paddocks and soil profiles. Inadequate sampling will most certainly either overestimate or underestimate the level of pathogen inoculum in a paddock.

SARDI provides training and accreditation to agronomists to collect soil samples for PREDICTA® testing using a PREDICTA® soil corer or equivalent.

PREDICTA® Soil corer

Sampling in field

General sampling guidelines

Sample handling

- If the sample is moist, keep it cool (below 10°C) until dispatch
- Deliver samples to the testing laboratory within 1-2 days
- Avoid leaving samples in plastic bags exposed to sun (i.e. on the dash board of a car or ute)

Individual samples

- Collect 30 individual cores using a soil corer with a 15cm depth by 1 cm diameter tip (sample weight should not exceed 500g if the correct corer tip used – avoid subsampling)
- Sample in W pattern across the area
- Collect samples within one hectare if the paddock is greater than one hectare in size
- Target productive cropping areas, avoiding the edge of paddocks, atypical small patches and low waterlogged areas or areas too close to trees

Number of samples required per paddock

The number of samples required per paddock depends on:

- The size and shape of the paddock
- The variability of soils and conditions within the paddock
- The uniformity of past cropping history
- The differences in past disease incidence
- The pathogen that is the main target of sampling

Sampling pattern

Open paddock or pivot

- Multiple representative samples are required per paddock
- Each sampling area is one hectare
- Sampling areas must be aligned with variations in soil conditions and past history

Permanent bays

- Each sampling area must be confined within a bay or a set of bays
- Multiple samples per paddock are required
- Sampling areas must be aligned with variations in soil conditions and past history
- Sampling areas must be aligned to planting schedule
- In cases of controlled traffic, sampling must be confined to cropped areas

Greenhouses

- Each sampling area must be confined to one greenhouse
- Normally one test per greenhouse will suffice, unless past cropping history or disease incidence varies
- Sampling must be conducted along row lines

Did you know?

Targeted samples taken from a defined area can be used if soilborne diseases are suspected to be a problem at that location.

Important note

When using PREDICTA® to enhance outcomes and findings from on-farm trials or ongoing monitoring of the cropping system, specific advice should be obtained on best sampling strategies to maximise the value of the data collected.

Disease risk thresholds

Establishment of disease risk thresholds requires field validation of the probability of disease occurring at different levels of inoculum in the soil for a specific crop and production environment.

- At low or non-detectable levels of inoculum, the risk of disease is low.
- At high levels of inoculum, occurrence and severity of disease depends on susceptibility of the variety, conduciveness of the environment and effectiveness of management options applied.
- High levels of inoculum do not mean disease will occur, but that there is a high risk if conditions are favourable for disease development.

If available, disease risk categories should be used as a general guide only. Other factors such as climate, management practices, soil type, crop type, variety, seasonal conditions and seedling health (if transplanted) should be considered in interpreting PREDICTA® results and assessing disease risk.

After repeated use of PREDICTA® tests within a cropping system, patterns observed in pathogen levels and disease occurrence can be used to refine interpretation.

Interpretation of disease risk is not available for all tests.

For some pathogens, the level of inoculum that poses a disease risk is lower than what can be detected. PREDICTA® testing is not a useful tool for assessing the risk of disease for these pathogens.

These tests can still be powerful tools for monitoring and decision making as they provide quantitative data on pathogen levels in cropping systems where infection and/or disease is occurring. Some examples of this include providing early warning of pathogen build-up and infection in a crop, assessing rotation crops as non-host break crops and evaluation of management strategies on infection levels and changes in inoculum.

What PREDICTA® testing does not do

PREDICTA® testing does not:

- Indicate the presence of pathogens that are not specifically included in testing. For example, beet cyst nematode will not be detected, as a test has not been developed for that pathogen
- Confirm whether disease will occur, as pathogen inoculum will only cause disease if conditions are favourable
- Confirm the disease will not occur, as a pathogen below detection limits may still cause disease if the conditions are favourable

What actions can be taken based on test results?

Knowing the risk of soilborne disease prior to planting maximises the range of management options available. It enables the implementation of a soilborne disease management strategy appropriate to the level of risk.

Depending on the crop, production system and environment, management options may include:

- Not planting in paddocks where risk is unmanageable
- Extending the length of the rotation
- Including non-host crops in the rotation
- Including a non-host cover crop in the rotation
- Choosing a tolerant or resistant variety
- Changing paddock scheduling to avoid growing in a high-risk timeslot
- Adjusting harvest scheduling to lower disease risk
- Applying soil amendment before planting
- Applying mulch or organic matter
- Adjusting tillage practices
- Utilising growth promotants or biological products
- Applying soil treatment
- Optimising nutrition to lower disease risk
- Optimising irrigation to lower disease risk
- Improving drainage

Disease tests

- Clubroot
- Root lesion nematodes
- Root knot nematodes
- Cavity spot
- Rhizoctonia
- Sclerotinia rot
- Pythium clade F and I
- Black leg
- Charcoal rot
- Black root rot
- Black dot
- Verticillium wilt
- Aphanomyces root rot

Clubroot

(caused by *Plasmodiophora brassicae*)

Clubroot is a devastating disease of brassicas. It can cause total crop failure if inoculum levels are high and conditions are favourable.

Inoculum can build to high levels in crops showing minimal symptoms and then badly affect the next crop.

PREDICTA® can quantify the level of *Plasmodiophora brassicae* inoculum in the soil which has been linked to the risk of disease (FIGURE 1). Testing prior to planting provides a useful indication of the risk of clubroot occurring in susceptible brassica crops.

There are several races of *P. brassicae* that cause clubroot. The PREDICTA® test is designed to detect all races of *P. brassicae,* but does not identify the race being detected in a sample.

Understanding risk of this disease by using PREDICTA® can assist in avoiding large economic losses.

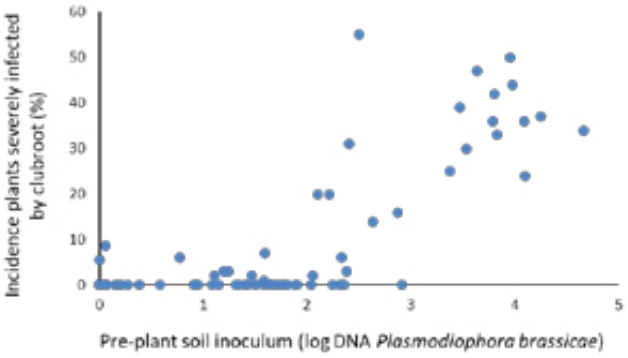


FIGURE 1: The relationship between the level of *Plasmodiophora brassicae* inoculum in the soil prior to planting and incidence of plants with severe clubroot impacting crop growth.

Root system badly affected by clubroot

Crop failure of brassica plant caused by clubroot

Crop failure of brassica crop caused by clubroot

Root lesion nematodes

(*Pratylenchus* spp.)

Root lesion nematodes are a significant horticultural pest. These microscopic plant-parasitic pests live in soil and roots, entering plant roots to feed and lay eggs. Affected plants grow poorly, crop growth is uneven and yields can be reduced. Infected plants may have chlorotic leaves, may appear wilted and roots can have dark brown/reddish lesions.

There is a strong relationship between pre-plant population of root lesion nematodes and level of infestation of root systems of susceptible crops.

PREDICTA® quantifies the population of the root lesion nematodes *Pratylenchus crenatus, P. neglectus, P. penetrans, P. thornei,* and *P. zeae*.

Quantification to a species level is important, as not all species are pathogenic to all crops. A high population of one species of root lesion nematodes may not impact a particular crop while a lower level of another species may reduce productivity of that same crop type.

Thresholds (pre-plant nematode population that causes economic loss) have been developed for most crops. These are not always defined for individual species of root lesion nematode and are best refined for the species present, specific cropping situation and varieties grown.

Thresholds for the pre-plant population of root lesion nematodes that pose an economic loss vary with crop, variety and production environment.

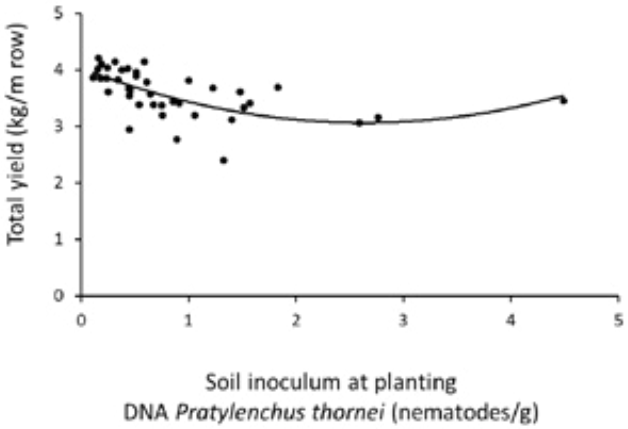


FIGURE 2: Reduced yield associated with population of *Pratylenchus thornei* at planting

Crop susceptibility, tolerance and economic damage thresholds vary with species of root lesion nematode, so management strategies should be considered for each species separately.

With the exception of *P. zeae*, root lesion nematodes are reported as nematodes per gram of soil equivalent.

There are other species of root lesion nematodes, such as *Pratylenchus brachyurus* and *P. coffeae* that are economically important nematodes of vegetable crops in regions of Australia. These nematodes will not be detected by current PREDICTA® testing.

Tolerant crops

Some crops and varieties have tolerance to specific species of root lesion nematode. Nematode populations will survive and may increase on the root systems of these crops, but productivity loss is less likely.

Non-host crops as a management tool

Non-host crops will result in a decline in the population of nematodes, as long as weed hosts are not present. These crops reduce risk to future susceptible crops.

PREDICTA® testing can be used to understand a crop's susceptibility, tolerance and impact on population build up.

Root knot nematodes

(*Meloidogyne* spp.)

Stunting and galling on carrots caused by root knot nematode

PREDICTA® quantifies the population of the root knot nematode species *Meloidogyne hapla, M. fallax, M. javanica, M. incognita and M. arenaria*.

All known species of root knot nematode in Australia are detected by the available PREDICTA® tests.

There is a strong relationship between pre-plant population of root knot nematodes and level of infestation of root systems of susceptible crops.

PREDICTA® *M. javanica/incognita/arenaria* is a combined test that detects all three species. Individual tests for these nematodes are available using the PREDICTA® potato research service, but the individual species tests are not as sensitive as the combined test and are not suitable for pre-plant risk assessment. For most crops susceptible to root knot nematode, all three species are pathogenic. Quantification to a species level is important for capsicums, as *M. incognita* is considered to be the only important species for this crop.

Nematologists have established thresholds (pre-plant nematode population that causes economic loss) for most crops. These are guides only and are best refined for the specific cropping situation, soil type, time of year and varieties grown.

PREDICTA® reports root knot nematodes in units of DNA (pg/g soil) rather than nematodes per gram of soil, so a conversion is required if comparing with established thresholds.

For highly susceptible vegetable crops including cucumbers, capsicums, sweet potato, peas and carrots, any detection of root knot nematodes is of concern. As the threshold for economic damage in these crops is low, sampling intensity must to be sufficient to be confident of detecting nematodes if they are present at a level that is economically important. Inadequate sampling technique or number of tests per paddock may result in failure to detect a nematode risk.

Tolerant crops

Some crops and varieties have tolerance to specific species of root knot nematode. Nematode populations will survive and may increase on the root systems of these crops, but productivity loss is less likely.

Non-host crops as a management tool

Non-host crops will result in a decline in the population of nematodes, as long as weed hosts are not present. These crops reduce risk to future susceptible crops.

PREDICTA® testing can be used to understand a crop's susceptibility, tolerance and impact on population build up.

Cavity spot

(caused by *Pythium sulcatum* and *Pythium violae*)

Pythium sulcatum is the most common cause of cavity spot of carrots in Australia. Cavity spot caused by *P. sulcatum* is most severe in summer and autumn harvested crops. PREDICTA® testing of *P. sulcatum* DNA levels in the soil prior to planting provides a useful indication of the presence of disease risk. Multiple tests (at least three individual tests) per paddock are required to adequately test for the presence of this pathogen.

At the standard intensity of sampling recommended for PREDICTA®, pre-plant soil testing has not always detected *Pythium violae* where carrots have developed symptoms in some patches throughout the paddock. Testing of soil after harvest from areas where cavity spot has occurred has detected the pathogen, but at low levels. These results indicate the threshold for disease risk in susceptible varieties may be close to or below the level of detection. Cavity spot caused by *P. violae* is most severe in winter and spring harvested crops.

Cavity spot symptoms on carrots caused by *Pythium sulcatum*

Rhizoctonia

(caused by *Rhizoctonia solani*)

Rhizoctonia solani has many anastomosis groups (AGs). Disease of a specific vegetable crop may be caused by one or more of these AGs. PREDICTA® tests for *R. solani* are AG-specific (includes AG2.1, AG2.2, AG3, AG4, AG8).

Distribution of *R. solani* in a paddock is known to be patchy and difficult to define. Testing of multiple samples is required to detect if *R. solani* is present. Specific sampling protocols to assess the risk of onion stunt caused by *R. solani* AG8 occurring have been established.

Knowing the AGs present in a paddock is important, as crop susceptibility varies with AG. This is important for planning rotations, as many crops and cover crops will host particular AGs, though symptoms may not be obvious. PREDICTA® testing provides a means to assess which crops are resulting in a decline or an increase in inoculum levels.

Not all AGs are detected by PREDICTA®. *R. solani* AG1 is an important pathogen of lettuce and carrots, but is not currently detected by PREDICTA® tests.

Carrot rot caused by *Rhizoctonia solani* AG2.2

Carrot rot caused by *Rhizoctonia solani* AG2.2

Sclerotinia rot

(caused by *Sclerotinia sclerotiorum and S. minor*)

The level of both *Sclerotinia minor* and *S. sclerotiorum* inoculum in soil is known to be related to disease incidence, though the latter also has an airborne spore phase which can result in widespread distribution from localised inoculum points. Testing in broadacre crops has demonstrated that the combined test for *S. sclerotiorum/minor* can provide a useful indication of the presence of disease risk. Results of PREDICTA® testing has demonstrated the ability to detect these pathogens in soil samples from vegetable paddocks where relatively low levels of disease have occurred. Knowledge of which species is present is important for test interpretation and for management of sclerotinia. These pathogens have a wide host range and are important pathogens of crops including beans, brassicas, carrots, celery and lettuce. Insufficient evaluation in vegetable crops has been conducted to validate the test's use for pre-plant assessment of disease risk.

Sclerotinia rot of lettuce

Pythium clade F and I

Tests for Pythium clade F and I are not species specific, with each test detecting a range of pathogenic *Pythium* species:

- Species detected by clade F include *P. irregular, P. sylvaticum, P. debaryanum, P. spinosum, P. paroecandrum, P. mamillatum*
- Species detected by clade I include *P. ultimum, P. splendens, P. heterothallicum*.

Interpreting these tests is more difficult than interpreting tests which only detect one pathogen species. When used in a paddock over time, PREDICTA® tests can provide an indication of changes in soil biology. High levels can indicate unfavourable soil conditions for seedling establishment and plant growth, an imbalance or that other disease pressure is present.

Blackleg

(caused by *Leptosphaeria maculans*)

Soil testing using PREDICTA® to assess the inoculum level of *Leptosphaeria maculans* has not provided a reliable indication of the risk of blackleg occurring in brassica crops. Disease is spread by airborne spores and can travel long distances to infect crops. The test will reliably detect the pathogen in infected plant tissue including infected crop residues that carry over inoculum.

Charcoal rot

(caused by *Macrophomina phaseolina*)

Macrophomina phaseolina has a wide host range and is an important pathogen of vegetable crops including beans, cucurbits, sweet corn, sweet potato and strawberries.

Limited testing in strawberry crops has demonstrated that the PREDICTA® test can provide a useful indication of inoculum presence in the soil prior to planting. Insufficient evaluation has been conducted in other vegetable crops to validate the test's use for pre-plant assessment of disease risk.

Black root rot

(caused by *Thielaviopsis basicola*)

Thielaviopsis basicola can be an important pathogen of crops including beans, lettuce, carrots and cucurbits. Only a low number of tests have been conducted in vegetable growing areas, with low levels of the pathogen detected in soils prior to planting. Insufficient evaluation in vegetable crops has been conducted to validate the tests use for pre-plant assessment of disease risk.

Black dot

(caused by *Colletotrichum coccodes*)

PREDICTA® testing for pre-plant assessment of disease risk has been established for black dot of potatoes. In other vegetable crops, mainly solanaceous crops, *Colletotrichum coccodes* is frequently present, but not known to be causing significant losses. In tomatoes, the pathogen can infect the plant and then cause anthracnose on fruit. Insufficient evaluation in vegetable crops has been conducted to validate the test's use for pre-plant assessment of disease risk.

Verticillium wilt

(caused by *Verticillium dahliae*)

PREDICTA® testing for pre-plant assessment of disease risk has been established for verticillium wilt of potatoes.

Verticillium dahliae has a wide host range and can cause productivity loss in crops including brassicas, lettuce and strawberry. Insufficient evaluation in vegetable crops has been conducted to validate the test's use for pre-plant assessment of disease risk.

Aphanomyces root rot

(caused by *Aphanomyces euteiches*)

Aphanomyces root rot is significant pathogen of peas and beans. No evaluation in vegetable crops has been conducted to validate the test's use for pre-plant assessment of disease risk.

How PREDICTA® can support your monitoring and management decisions

- Crop monitoring and management
- Identification of the issue
- Monitoring cropping system
- Assessing effectiveness of management strategy

Crop monitoring and management

PREDICTA® testing of soil or root systems can quantify pathogen levels at any point of crop growth. Testing can provide insight into the cause of crop symptoms being observed, and provide an early warning for some soil borne diseases, such as root knot nematodes (FIGURE 3).

Monitoring of root knot nematode levels in greenhouse production of capsicums (expected growth period nine months).

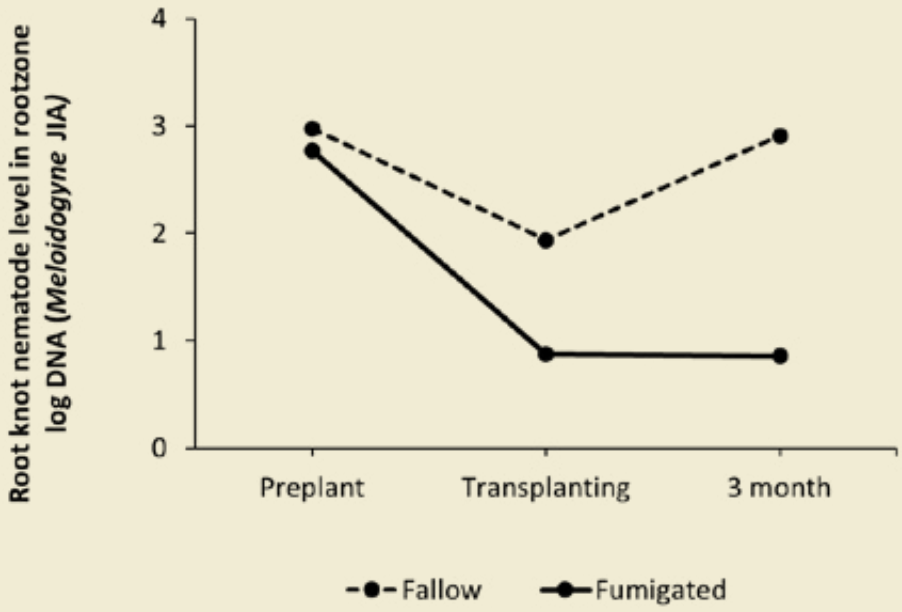


FIGURE 3: Testing indicates fallow period reduced levels of root knot nematode prior to planting, but not enough as the population has increased three months into crop. Symptoms of disease would be visible on plants and roots and crop productivity will be reduced. Testing indicates the population was reduced by fumigation and has remained low three months into crop, justifying the use of fumigation.

The greenhouse was fumigated prior to planting except for a small untreated area which relied on a period of bare fallow to reduce nematode population.

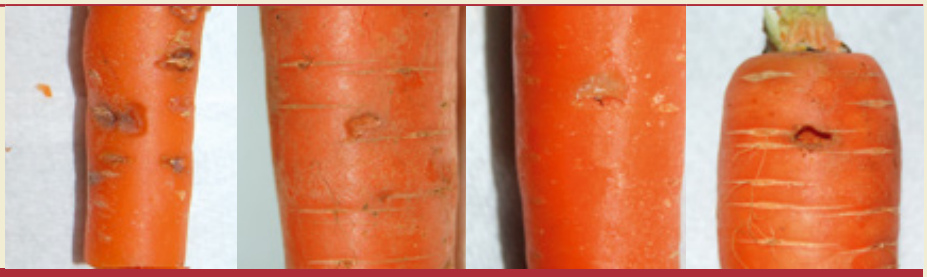
Identification of the issue

Correct diagnosis of the pathogen causing disease symptoms is central to implementing an effective management strategy. Incorrect diagnosis results in costly treatments being applied for no benefit with loss in productivity continuing.

Results of a PREDICTA® test are not a diagnosis, but when used by experienced plant pathologists they can assist diagnosis by:

- Identifying the pathogen down to a species or group when the cause of disease is known
- Confirming if the pathogen is present in disease symptoms when the pathogen is difficult to isolate
- Quantifying pathogen levels in plant tissue or soil from around diseased plants

Cavity spot of carrots can be caused by *Pythium sulcatum* or *P. violae*. Symptoms of both species can be similar. Cavities in carrots similar to those caused by *P. sulcatum* or *P. violae* can be caused by other pathogens, pest damage and physical soil constraints. In these cases, management aimed at controlling *Pythium* will not improve the outcome.

What is the cause of this cavity symptom?				
PREDICTA® testing can quantify pathogen levels in symptoms, assisting correct diagnosis				
Pythium sulcatum (kDNA / g sample)	4022	Below detection	Below detection	Below detection
Pythium violae (kDNA / g sample)	Below detection	62	Below detection	Below detection

Correct identification of the cause of cavity symptoms helps to target control options to minimise yield and quality loss. It also informs the development of future management strategies.

Important note

Presence of a pathogen does not mean it is causing disease, but the quantification of pathogen levels may indicate which ones are involved. This is particularly useful where a disease complex is suspected.

Monitoring cropping system

Rotations and cover crops are an integral part of many cropping systems. Regular PREDICTA® testing determines how effective these strategies are at managing the level of inoculum for pathogens.

Rhizoctonia solani AG2.1 has a wide host range, including vegetable and broadacre crops. It can be pathogenic on vegetables including brassicas, carrots and potatoes. Some crops will host *R. solani* AG2.1 without obvious symptoms. Monitoring provides an indication of the build-up or decline of inoculum than is occurring within a crop production system. Crop type is only one factor in inoculum change. Other factors include time of the year, nutrition, growing conditions and interactions with other soil microbes.

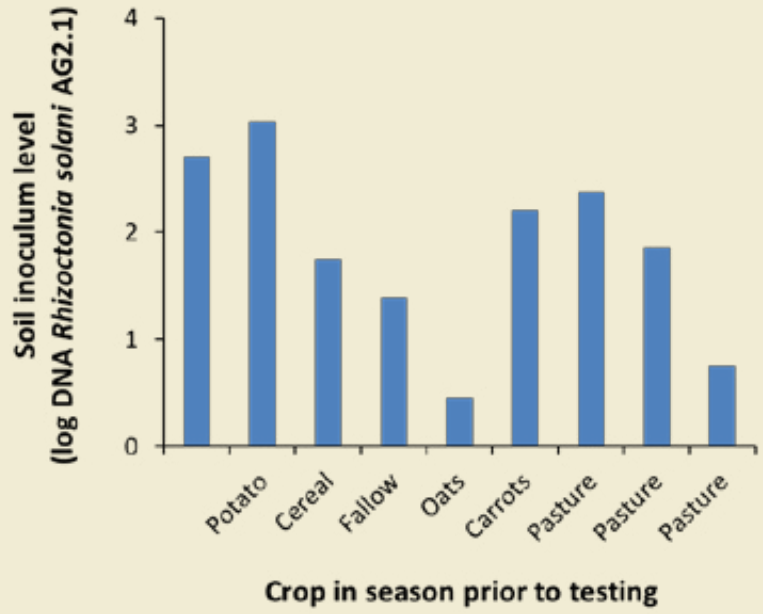


FIGURE 4: Example of annual monitoring of *Rhizoctonia solani* AG2.1 levels in a paddock.

Assessing effectiveness of management strategy

The effectiveness of treatments is best determined by quantifying the impact on yield and quality that contribute to profitability.

Sometimes disease does not occur, making it difficult to know if the strategy has had an impact. Disease symptoms may be due to a number of reasons. The treatment can have multiple effects and the reason for benefit or failure may not be clear. Using PREDICTA® to quantify pathogen levels can clarify what is happening and confirm the reason for the benefits observed.

Impact of pre-plant soil treatment on the level of *Pythium sulcatum* (cause of cavity spot) in an on-farm carrot trial was investigated.

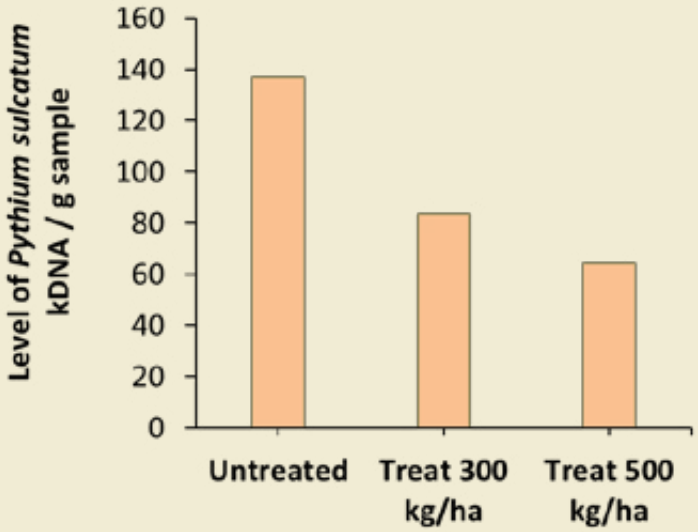


FIGURE 5: Results of peel testing at harvest indicate that *P. sulcatum* is the likely cause of minor cavity spot symptoms observed in an untreated area. Treatment reduced pathogen levels in peel of carrots indicating treatment has positive impact on cavity spot management.

Further information

https://pir.sa.gov.au/research/services/molecular_diagnostics

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