

Management of Potato Cyst Nematode in New Zealand Potato Crops

Introduction

Potato cyst nematode (PCN) is the term used to describe two cyst forming species of potato nematodes (*Globodera pallida* and *Globodera rostochiensis*). The cyst is a hard, protective shell that allows PCN to survive for many years. PCN is transmitted through movement of infested soil and has the capacity to severely reduce yields and impact on export market access. PCN has been present in New Zealand since 1972 and is managed through industry advice and grower practices. It has not been under any official government control programme since 1980.

The industry has adopted a PCN certification programme for seed potato production and also a MPI official assurance programme for potato exports. Production of table potatoes and processing potatoes for the domestic market is not subject to any survey or certification requirements for PCN.

This factsheet provides guidance on preventing the spread of PCN and ways of managing the impact of PCN in potato crops. This factsheet updates two earlier factsheets published by Potatoes NZ in 2011¹.

Potato Cyst Nematode

PCN cysts can contain up to 500 eggs. The cysts remain in the soil until they are stimulated to hatch by the presence of water and host crop roots (such as potatoes). The emerging nematodes penetrate the roots just behind the root tip and feed on the roots, reducing water uptake by the plant. The root systems of infected plants may be poorly developed, and tubers may be distorted or small in size, with yields decreasing as infection rates increase. PCN infection may not initially be detectable above ground, but as population densities increase infected plants may wilt, and often have spindly stems.



Crop damage due to PCN. Note the patches of weaker or stunted plants and wilting.

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¹ "Stopping the spread of potato diseases: an on farm best practice guide, (May 2011)", and "Managing PCN with resistant cultivars (August 2011).

Below ground the cream or brown coloured cysts may be seen on potato roots.



PCN attached to potato roots.

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PCN cysts. Image © United Nations, 2014 UNECE (ECE/TRADE/416) 2014. © SASA

Potatoes are a main host of PCN, but other Solanaceous crops and weeds (such as nightshades) are also hosts. Volunteer potatoes in other crops can also contribute to the long-term survival of PCN

Causes of PCN Spread

Potato cyst nematode and a wide range of other diseases including Verticillium wilt, violet root rot, common scab, powdery scab and PMTV can be spread when soil is moved between fields and from one farm to another. PCN can severely reduce potato yields and affects export market access, and once it becomes established on a piece of land it is very difficult to

remove. Only a few chemical control options are available, and PCN can survive in the soil for up to 20 years. The main risks for spreading PCN are:

- seed tubers, particularly saved seed from uncertified crops,
- soil on machinery, boots, vehicles etc, and
- waste from table or processing potatoes such as reject tubers, water from washing, and soil.

Preventing spread of PCN

Seed potatoes

Seed potatoes have the potential to carry PCN and introduce it into a new area. All certified seed potato crops grown in New Zealand are surveyed for PCN so the risk posed by certified seed potatoes is minimal. Seed from unsurveyed crops can pose a serious risk, so commercial growers should only grow from certified seed potatoes.

Soil movement

The movement of soil is a common way of spreading PCN. Even a small amount of soil is enough to spread PCN, so soil movement must be restricted as much possible. Machinery, bins and containers, or anything else which is used in the field, can easily pick up soil which can be dislodged the next time the equipment is used. If the soil is infested with PCN then this will lead to a new area becoming contaminated. High pressure washing is the best way to remove soil and the potato cyst nematode from equipment.

Potato wastes

Waste such as reject tubers, wash water, and soil from processing factories or table potato packing operations can all carry PCN. Feeding out reject tubers or spreading this waste onto fields can lead to new infestations so should be avoided. Potato washing water should be filtered or ponded with the settled sludge disposed of in a landfill.

Cleaning machinery, vehicles, and bins

It is essential to clean equipment and bins when moved between farms because it is often difficult to be certain whether the other farm's soil is clear of PCN. All farms or blocks of land used for potato growing should have a specific area which is used for the washing down of machinery.

Tips for locating washdown areas:

- Location: An open area close to property entrances and located as far as possible from growing areas.
- Drainage: Ideally a sump or a waste water collection area for drainage of water, soil and plant debris. If this is not possible ensure that waste water does not run-off onto production areas.
- Size: Enough room for large machines and vehicles to enter and move around.
- Cleaning equipment: Dedicated high pressure hoses or waterblaster.

- Surface: Concrete, gravel or bitumen is ideal. A grassed surface is not recommended due to the potential for some pests to be spread by soil and on plant matter.
- Timing: Ideally cleaning will take place on the property the soil has originated from rather than transporting machinery and/or equipment to a new location to clean.
- Signage: Clean down areas should be signposted and directions provided from the property entrance. This will ensure visitors are aware of the clean down facility and can report to it on arrival.



Washing machinery, vehicles, and bins with a high pressure hose or water blaster is an effective way of preventing the spread of PCN.

A short checklist is a helpful way of identifying what needs to be cleaned on each piece of machinery. Tires, wheel wells, and any parts of the machinery which are in contact with the ground are the most important and obvious areas, but the checklist should also include any out of the way or hidden areas.

The washing procedure for machinery and vehicles is as follows:

- Dislodge any large clods of soil from the machinery before leaving the field.
- Drive the machinery directly to the washing area, avoiding other fields if possible.
- Wash with a high-pressure hose or water blaster, working from top to bottom.

- Where possible steam clean after washing if the equipment has been used in a field which is known to be infested with PCN.
- Follow a checklist for each piece of machinery to ensure every part has been cleaned.

All farm machinery and equipment such as bins, tools, boots, or containers that are in contact with soil can spread PCN and other soil-borne diseases. Simple procedures will keep PCN out of a field, but if it is introduced into a field it is almost impossible to eradicate.

Contractors and visitors

Contractors and other visitors such as crop monitors, sales reps and agronomists may visit several farms in quick succession, so their vehicles can easily spread infested soil. Control the movement of contractors and other visitors on your property by using signage that provides contact phone numbers or directs visitors to the office so you can give instruction on requirements for farm hygiene. Keep a register of visitors. When the same tools and machinery are used at several farms this can pose a significant risk. It is important to make sure that contractors are aware of the risks they pose and that they appreciate that good farm hygiene is essential to maintain productivity. Consider including cleaning requirements in any contractual arrangements you have with contractors or other service providers that visit your property.



Post signage at the main entry points to the farm.

Soil is easily picked up by vehicles driving through farms. As well as this, when crops are transported soil can be dropped onto roads and then picked up on the tires of passing vehicles. This soil can then contaminate other farms. Try to minimise the number of vehicles which enter your fields and also the number of entry points. Be particularly wary of vehicles which have visited other properties which may be infested with PCN or other diseases (such as the vehicles of merchants, agronomists, or contractors). Ensure that contractors and other visitors are aware of the location of sites for washing down equipment and boots.

Boots

When leaving a farm or block of land any clods of soil should be removed from boots with a stiff brush, and boots should be washed. If disinfecting/sanitising boots be aware that soil must be removed first. The uses of disinfectants and sanitisers without removing soil first will not be effective as the soil and organic matter deactivates the disinfectants/sanitisers.



Boots can easily carry soil between fields and farms. Brush and wash boots to remove all soil.

Grazing animals

Animals grazing on pasture can pick up and transport soil and plant material. Some diseases can also survive an animal's digestive system meaning when stock are moved a disease can be spread with the stock. Growers should be aware of these risks when choosing stock feed e.g., reject potatoes and when livestock are moved between fields.

Leased land

Farm hygiene is particularly important when land is leased as records may not be available of the previous crop history. Get as much information as possible on the history of the land, particularly regarding potato cultivation, whether potatoes have been fed out on the block, and the results of any PCN testing.

Management of PCN

Once fields are infested with PCN it is very difficult to eliminate the infestation. The objective should be to minimise the impact on potato production and prevent spread to other fields. At low levels PCN can have little impact on yields. Depending on soil type PCN populations can decline over time to levels that are below damage thresholds.

Resistant cultivars

Some potato cultivars are resistant to PCN which allows the use of resistant cultivars to form an important part of a grower's PCN control strategy. It is important to note that resistant cultivars will prevent PCN from reproducing, but these cultivars are still susceptible to the damage PCN causes to the plant's roots. If the PCN population is above the damage threshold of 15-20 cysts per ml of soil, then yields will be reduced.

It is also important to be aware that there are two species of nematode that make up the PCN complex in New Zealand (*Globodera rostochiensis* and *Globodera pallida*). Potato cultivars can be resistant to one, both, or neither of these nematodes. If using resistant cultivars as part of a PCN control strategy it is vital to find out which nematode species occurs on the farm and select potato cultivars which are resistant to that species. Your seed supplier can provide information on PCN resistance of common varieties.

The resistance characteristics of the top 10 potato varieties are listed in Table 1, below. Potato cultivars which suffer less than 5% infection when grown in soils infested with PCN are categorized as "Resistant", while infection rates of 5-15% are categorized as "Partial resistance", and infection rates of over 15% result in that cultivar being categorized as "Susceptible". All resistance data is courtesy of Plant & Food Research except where marked with an asterisk, in which case data is from the website www.europotato.org.

Table 1: Resistance rating of the top ten potato varieties grown in New Zealand.

Cultivar	<i>Globodera rostochiensis</i> resistance	<i>Globodera pallida</i> resistance
Agria	Resistant	Susceptible
Annabelle	Resistant	Susceptible
Fianna	Resistant	Partial resistance
Ilam Hardy	Susceptible	Susceptible
Innovator	Susceptible	Resistant
Moonlight	Resistant	Resistant
Nadine	Resistant	Partial resistance
Ranger Russet*	Susceptible	Susceptible
Rocket	Resistant	Partial resistance
Russet Burbank	Susceptible	Susceptible
Vivaldi	Susceptible	Susceptible

Crop rotation

If potato cultivars susceptible to PCN are planted then rotations of ten years or more between potato crops are the best strategy to suppress PCN populations. If a small number of PCN cysts are introduced into a field these will not have the opportunity to infest another crop for at least ten years, and by that time the number of cysts which are still viable will have dropped enough to minimise the damage they might cause.

Tubers left behind at harvest (ground keepers) can regrow amongst other crops and can be enough to allow PCN populations to be maintained or even increase. The presence of ground keepers eliminates the benefits of crop rotation. Ground keepers must be removed in intervening years if crop rotation is to be effective. If PCN resistant cultivars are planted then shorter rotations may be possible, depending on soil type and location. Rotations of as little as four years may be possible in some locations.

Nematicides

Nematicides (chemicals which kill nematodes) can be an effective addition to a rotation strategy and will often be applied if a potato cultivar which is susceptible to PCN is planted. The only product currently registered for use in potato crops is Fenamiphos (under trade names such as Canyon®, Fenafos 400, Nemacur®, and Nematek® 400EC). Always follow the label directions and speak with your agrichemical advisor for the best information on products and application.

Pre-plant soil testing

Because PCN can survive in the soil for many years between potato crops, it is recommended that a pre-plant PCN test is carried out in land which has an unknown history (e.g. leased land). The PCN test involves sampling soil cores from the property and testing for nematodes in a laboratory. Crop consultants or organisations such as AsureQuality Ltd or SGS NZ Ltd may be able to perform this sampling. This will allow the grower to make informed planting decisions.

Sidebar/text box

- Prevent the spread of PCN
- Once PCN is in the soil it is almost impossible to remove
- PCN reduces yield and restricts export market access
- PCN is easily spread on soil associated with tubers, machinery, vehicles, bins and even boots
- Wash machinery and equipment before moving between farms
- Manage movement by contractors and visitors
- Grow only certified seed potatoes
- Use long crop rotations and resistant varieties to minimise PCN impact



Acknowledgements

This fact sheet is a revision and combination of two previous Potatoes NZ publications: "Stopping the spread of potato diseases: an on farm best practice guide, (May 2011)", and "Managing PCN with resistant cultivars (August 2011)". Resistance information supplied by Plant & Food Research for the latter publication has been reprinted. Several images, as acknowledged in the text, were sourced from the UNECE Guide to Seed Potato Diseases, Pests and Defects, United Nations 2014.

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