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Globodera Alliance Newsletter

Risk and Landscape Ecology of the Pale Cyst Nematode in Idaho

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Invasion and spread of plant parasitic nematodes

The pale cyst nematode (PCN), *Globodera pallida,* is a globally regulated plant parasitic nematode that can survive in soil for up to 30 years in the absence of its potato host. In highly infested fields, potato cyst nematodes can reduce tuber yields up to 80% and are spread mainly through soil, tubers or farm equipment. Epidemic spread of PCN poses a risk to Idaho's economically important potato crop. In order to contain PCN, a comprehensive understanding of the potential for spread and risk that PCN poses to the industry is needed. Invasion of plant parasitic nematodes can undergo several important phases which contribute to their spread:

- Entry of the nematode
- Establishment through local reproduction
- Integration into the cropping system
- Passive spread through mechanisms such as movement of agricultural equipment

Inside this issue:

First Law of Geography:

'Everything is related to everything else, but near things are more related than distant things.'

Waldo Tobler (1970)

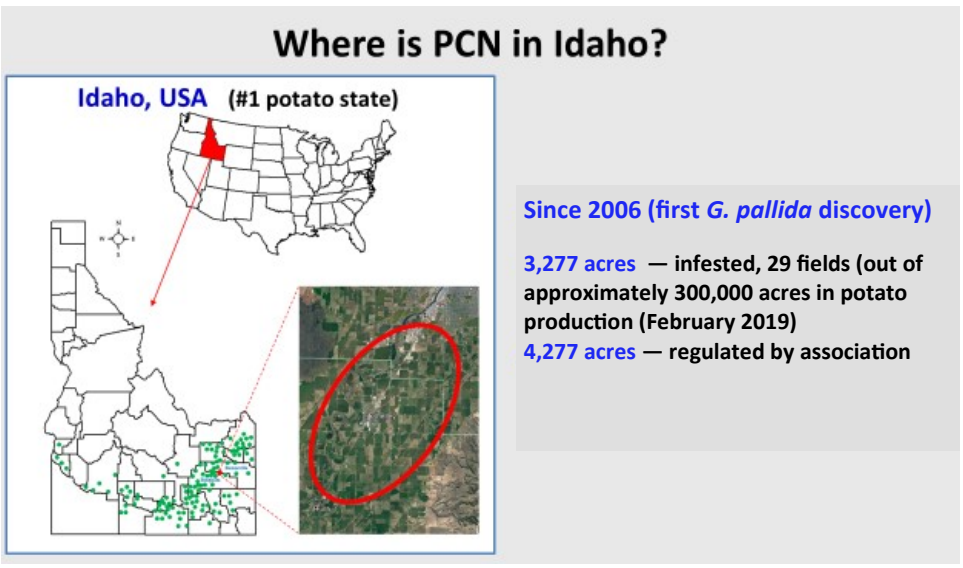

Fig. 1. Map of the state of Idaho along with the major potato production areas in green (far left) and location of the potato fields infested with *Globodera pallida* in southeastern Idaho (represented by red dot). The infestation area, outlined in red, is within an 8.5 mile radius and in Bonneville and Bingham counties.

The situation of PCN infestation in Idaho

Globodera pallida was first detected in the U.S. in the state of Idaho in 2006, and as of November 2018, 3,277 acres are infested (Fig. 1). USDA-APHIS and the Idaho State Department of Agriculture (ISDA) have implemented a containment and eradication program to prevent PCN spread to other fields. In fields infested with PCN, the program outlines:

- Restrictions on the movement of soil and certain plant materials;
- Prohibition of planting potato and other solanaceous crops;
- Sanitation procedures for articles such as farm equipment moving between fields; and
- Soil fumigation of infested fields as part of the eradication program.

Landscape ecology and potential spread of PCN in Idaho

By conducting spatial analysis of the infestation, we can understand the ability of this nematode to spread in the region as well as within an infested field. Spatial analysis gives us information on the infestation pattern which can then be used to predict the ability of this invasive nematode to spread. These predictions are based on Tobler's first law of geography:

'Everything is related to everything else, but near things are more related than distant things.'

Our spatial analysis showed that the infestation in Idaho had the following characteristics:

- The infestation in Idaho is highly aggregated (Fig. 2).
- Cysts from contaminated fields were spread to nearby non-infested fields through a contagion type effect which contributed to new infestations.
- Cysts were most likely transported in soil on contaminated agricultural equipment.
- PCN infestation in a field is also highly aggregated and often coincided with the field entrance (Fig. 3).
- Phytosanitary measures, such as prohibiting planting of a potato crop, and mandatory sanitation of all equipment exiting a field mitigated the risk of spreading PCN.
- The use of soil fumigants contributed to a significant reduction in viability of the PCN.

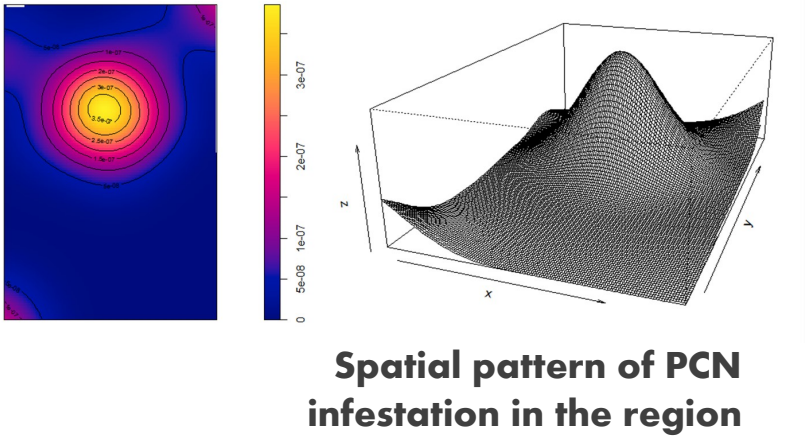

Fig. 2. Spatial pattern of the PCN infestation in Idaho. The color intensity is described as follows: yellow corresponds to the highest density of infested field locations and blue to the lowest density.

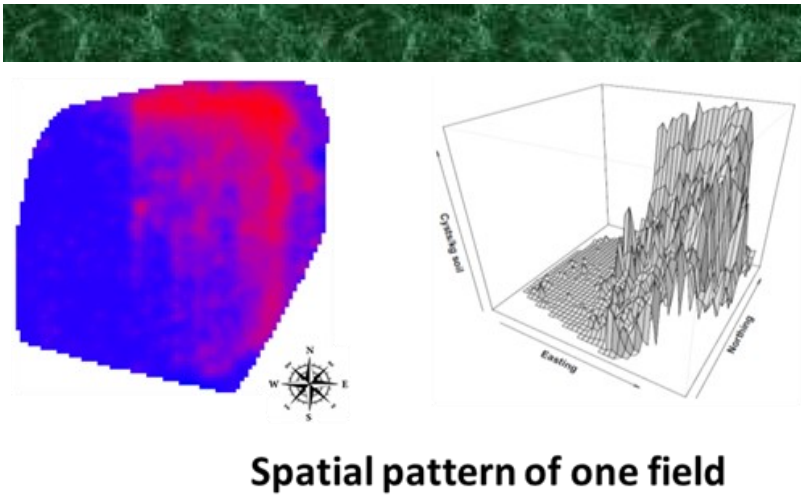

Fig. 3. Spatial prediction maps of one field infested with the pale cyst nematode *Globodera pallida* in Idaho. The red color intensity corresponds to locations of high cyst densities in the field and blue corresponds to locations of low cyst densities.

Understanding the impact of the PCN on potato yield

We predicted the impact of PCN on potato yield by simulating potato yield losses in Idaho field conditions using the potato crop model available in the Decision Support System for Agrotechnology Transfer (DSSAT) platform. The experimental data for predicting yield losses for Idaho conditions came from three trials that were conducted under greenhouse conditions at the University of Idaho PCN facility. The DSSAT model predicted the following:

- Tuber yield reached a maximum yield of 39 tons/acre in non-infested soil.
- At an infestation level of 80 eggs/g. soil (equivalent to 36,364 eggs/lb. soil), yield was reduced by 40 to 87% compared to the non-infested soil.
- As determined by DSSAT, PCN has potential to cause considerable damage to potato under Idaho conditions (Fig. 4).

De-regulation of infested fields in Idaho

USDA-APHIS provides steps for deregulating *G. pallida* infested fields:

Step 1 – Viable encysted eggs are no longer being detected (collected eggs are tested for viability).

Step 2 – Three rounds of a greenhouse bioassay using field cysts to confirm absence of nematode reproduction on a susceptible potato.

Step 3 – An in-field bioassay where fields can be released from quarantine status when soil surveys following each of three susceptible potato crops are negative for viable eggs.

As of February 2019, 22 fields (2,395 acres) have passed step 1 (no viable eggs found) and 18 fields (1,780 acres) have passed step 2 (no reproduction). Through quarantine, fumigation and regular soil testing, the PCN infestation is being contained and progress is being made towards the goal of eradicating this invasive pest.

About the GLOBAL Project

GLOBAL stands for "*Globodera* Alliance", an international group of research, extension, and education professionals working to eradicate *Globodera spp.* in U.S. potato production.

GLOBAL Project members include scientists from the University of Idaho, Oregon State University, Cornell University, U.S. Department of Agriculture (USDA), Agriculture and Agri-Food Canada, The James Hutton Institute, and the French National Institute of Agricultural Research.

Follow the GLOBAL Project online at:
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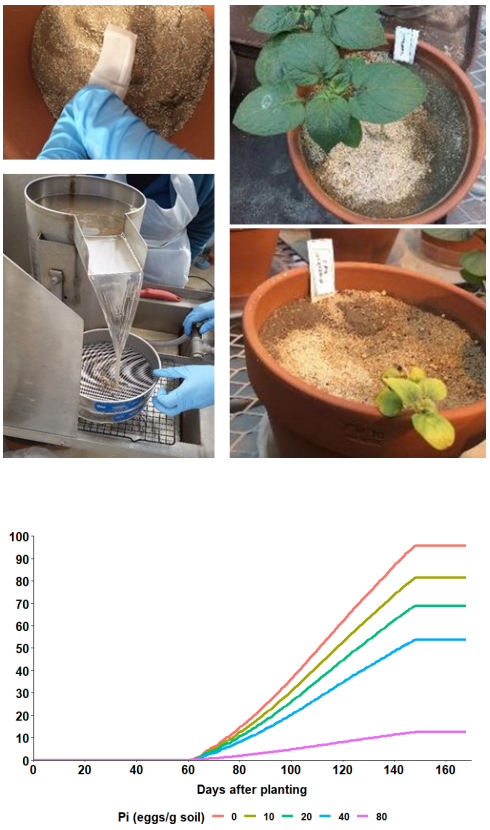

Fig. 4. Assessing the impact of the initial densities of *Globodera pallida* on potato yields in greenhouse conditions followed by cysts extraction and potato biomass evaluation (right). When the initial nematode density was 36,364 eggs/lb. soil, fresh tuber yield was reduced between 39% and 87% and the potato plants showed symptoms of yellowing, stunting and poor root development. The greenhouse data was used to simulate potato yield loss in Idaho field conditions using the DSSAT potato crop model (bottom right).

Upcoming Events:

2020 Idaho Potato Conference & Ag Expo

January 21-23, 2020
Pocatello, Idaho

GLOBAL Project Investigators will be presenting several workshops at the Idaho Potato Conference, including an update on work underway to control PCN and develop PCN resistant potatoes.

For more information: **www.idahopotatoconference.com**

Washington Oregon Potato Conference

January 21-23, 2020
Kennewick, Washington

For more information: **www.potatoes.com/potatoconference**

Potato Expo 2020

January 14-15, 2020
Las Vegas, Nevada

For more information: **www.potato-expo.com**

7th International Congress of Nematology

May 3-8. 2020
Antibes Juan-les-Pins, France

GLOBAL Project will be hosting a symposium on potato cyst nematodes at this 7th ICN meeting.

For more information: **www.esn-online.org/international-congress**

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GLOBAL Project scientists, advisory board, and support staff tour the Greenhouse and Plant Breeding Facilities at Cornell University.

GLOBAL Advisory Committee consists of potato industry, state and federal regulatory and academic individuals who have volunteered their time and efforts. We thank them!

GLOBAL Advisory Committee

- Lorin Clinger, potato grower
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