Potato cyst nematode – biology, distribution and impact on the potato industry

Xiaohong Wang
USDA-ARS & Department of Plant Pathology and Plant-Microbe Biology
Cornell University, Ithaca, NY 14853

The two species of potato cyst nematodes (PCN), *Globodera rostochiensis* (golden nematode) and *G. pallida* (pale cyst nematode), are the major pests of potato causing significant economic losses.

These nematode pests are microscopic root parasites that infect a small range of solanaceous plants including the economically important crops of potato, tomato and eggplant. During the nematode life cycle (**Figure 1**), infective second-stage juveniles hatch from eggs within the cysts in the soil and penetrate host roots to induce permanent feeding sites called syncytia for development and reproduction. After feeding, the nematode undergoes three molts to become a reproductive adult. PCN reproduces sexually. After fertilization, eggs develop within the female body. Eventually, the female dies and its remaining cuticle forms a protective cyst that encloses several hundred eggs. The cyst protects the enclosed nematode eggs and juveniles from harsh environmental conditions, enabling them to survive in soil without a host potato crop for more than 25 years.

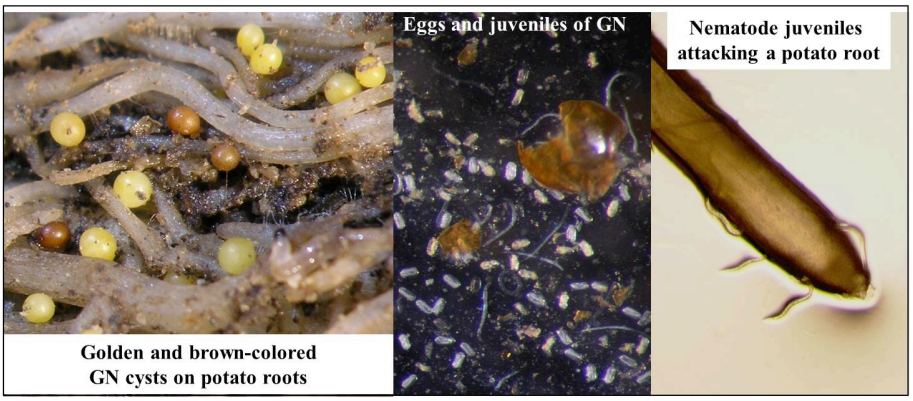

Figure 1. Life cycle of potato cyst nematode *Globodera rostochiensis*.

It is generally believed that PCN pests are indigenous to the South American Andes and were introduced to Europe and then to other parts of the world where potatoes are grown.

Prior to 2006, only the golden nematode (GN) was present in the US. GN was first discovered in New York in 1941 and has been successfully confined within NY due to strict quarantine regulations and management strategies. In Canada, prior to 2006, one or both PCN species were reported only in restricted areas of Vancouver Island and Newfoundland. Unfortunately however, in 2006, the pale cyst nematode was detected in Idaho; this was the first discovery of a second PCN species in the US. In the same year, soil samples collected from a potato field in St-Amable, Quebec were identified to contain GN cysts, revealing for the first time the introduction of PCN to the inland area of Canada. In 2007, GN was also detected in seed potato production fields of Alberta, Canada. Furthermore, in 2008, a *Globodera* species described as *G. ellingtonae* that shares similar morphological features with PCN was isolated from a field in Oregon and two

fields in Idaho. *G. ellingtonae* can reproduce on potato plants. These new discoveries (**Figure 2**) emphasize the importance of PCN control and regulation in North America.

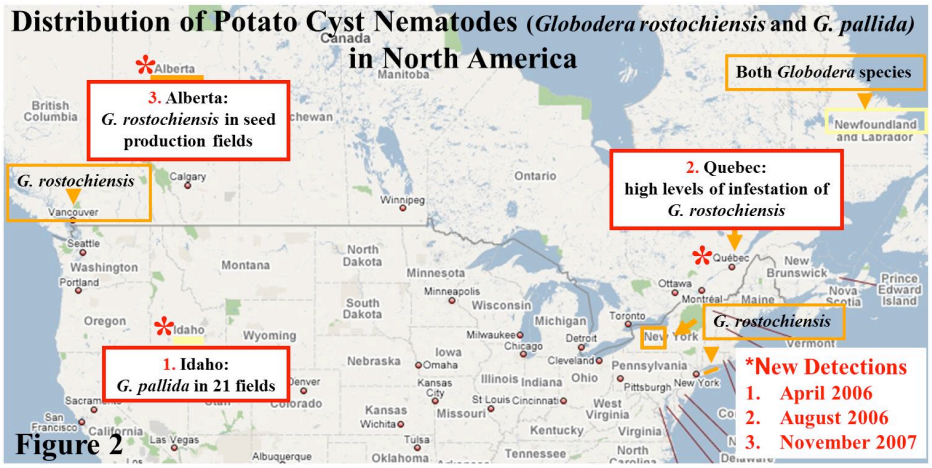

Figure 2

Potato cyst nematodes are regulated pests in many countries. Therefore, their discoveries are often associated with quarantine and trade embargoes. Current control of GN in the US relies on strict regulatory and quarantine procedures and the use of resistant potato varieties to prevent its further spread from the state of New York. However, in addition to the endemic pathotype, Ro1, a new pathotype, Ro2, has become established that is virulent on potato cultivars resistant to Ro1. To date, there are no commercially-available potato cultivars resistant to Ro2. The pale cyst nematode is more difficult to control than GN because of its higher degree of genetic variability and the lack of potato cultivars with full resistance.

The emergence of GN Ro2, the recent detections of PCN in the US and Canada, and the worldwide occurrence of PCN indicate the potential for these nematode pests to become established in all major potato production areas of the US. The use of nematode resistant cultivars is the most economical and environmentally-safe means of cyst nematode control. However, the lack of commercially-acceptable resistant cultivars and the genotypic variability in PCN field populations pose a serious threat to the US potato production and trade.

The ARS-Cornell golden nematode program at Ithaca, NY, is the only research program in North America that has hands-on experience and expertise in the biology, resistance breeding, and management of the nematode. Research focuses include: 1) Studying the fundamental biology of the interactions between PCN and potato; 2) Developing GN resistant potato varieties; 3) Developing molecular diagnostic tools for the identification of nematode species and pathotypes; 4**)** Developing new nematode control and management strategies. Since GN and the pale cyst nematode are very closely related, discoveries from the ARS-Cornell program are directly applicable to the control and management of the pale cyst nematode.

Potato cyst nematodes are pest of national importance. There is an urgent need to develop a coordinated national program for detection, control and management of these devastating potato pests. The establishment of a coordinated national PCN program would benefit the US potato industry and allow continued interstate and international potato trade.