



United States Department of Agriculture

Potato Cyst Nematodes National Survey Guidelines

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United States Department of Agriculture (USDA)
Animal Plant Health Inspection Service (APHIS)
Plant Protection and Quarantine (PPQ)

Emergency and Domestic Programs (EDP)
Field Operations (FO)
National Identification Service (NIS)
Science and Technology (S&T)

Introduction

Potato cyst nematodes are soil-dwelling, unsegmented roundworms that feed on the roots of many solanaceous plants, but are of major concern in potato (*Solanum tuberosum*) production systems where they can cause great yield losses (Sullivan et al., 2007; Varandas et al., 2020). The cyst stage of these nematodes can remain viable in the soil for multiple decades (EFSA, 2012; Sukhanova et al., 2022), making them very difficult to eradicate once present.

Two species of quarantine significant potato cyst nematodes have been detected in the United States, the pale cyst nematode (*Globodera pallida*) and the golden nematode (*Globodera rostochiensis*). Pale cyst nematode was detected in Idaho in 2006. In the following year, PPQ and Idaho State Department of Agriculture (ISDA) implemented federal and state quarantines to contain and eradicate the pest (USDA-APHIS, 2011). Since implementation of these regulatory efforts, the nematode remains limited to two counties in Idaho domestically. The golden nematode was first reported in New York in 1941. In 1944, PPQ and the New York State Department of Agriculture and Markets (NYS-AGM) implemented federal and state quarantines; thereby, restricting the movement of soil and equipment that may be contaminated with golden nematode (NYS-AGM, 2026). Since then, over 90% of the area that was once under quarantine has been deregulated due to joint state and federal regulatory efforts (NYS-AGM, 2026). Since the start of the joint federal and state quarantine programs, neither of the two potato cyst nematodes of quarantine significance have been documented in any other states.

Although no detections of the two known quarantine potato cyst nematodes have been reported from other states, it is important to monitor domestic potato production systems to ensure they remain free of potato cyst nematodes. Seed potatoes pose the greatest risk (pathway) for potato cyst nematode introduction and contamination between fields, as planting infected seed potatoes can contaminate new fields where the nematodes are not known to occur. The implementation of this survey is critical to safeguarding the U.S. potato industry. PPQ recommends implementing a national survey plan for the detection of potato cyst nematodes in all potato-producing states. Early detection may help prevent the spread of potato cyst nematodes to other areas. Surveying 1% of the commercial seed potato acreage, as well as all other land used for seed potato research (e.g., universities, state or federal government, or other research organizations), provides the necessary data to demonstrate pest free area for potato cyst nematodes to trading partners. This will help ensure that the entire seed potato supply, including seed from research trials, variety evaluations, post-harvest evaluations and farm-saved seed, is free from potato cyst nematodes.

The State Plant Health Director (SPHD) and State Plant Regulatory Official (SPRO) in each state will determine which entity/entities are to implement the survey. The state department of agriculture may decide to implement the survey in part or in its entirety. The state may also decide to enter into an agreement with the seed potato certification agency, agriculture extension

service, or others to implement the survey. However, all sampling must be conducted by or under the supervision of a federal or state plant regulatory agency so that the samples are “official samples.” Officials in each state will decide how best to leverage available resources in the most effective manner.

Sampling Methodology

The full-field detection survey will take place on seed potato acreage, commercial potato acreage and land used for potato research. The appropriate sample size is 2000 cubic centimeters (cc) or about 5 pounds (lbs.) of soil per acre to balance detection sensitivity against survey resource costs. Soil surveys conducted soon after potato harvest are preferred to take advantage of the soil mixing that occurs when potatoes are harvested and the increase in nematode populations during the growing season. However, because eggs in cysts remain viable for many years, soil surveys can be conducted at any time of year following production of a potato crop. Each sample will be processed in its entirety at a PPQ or National Plant Diagnostic Network (NPDN) screening laboratory. Refer to the [Appendix](#) for the Specimen Forwarding Protocol.

Full Field (Grid) Survey

Fields selected for survey must be sampled in their entirety using a fixed sampling pattern that does not exceed a 7×7 pace grid pattern, collecting one 2000 cc soil sample (approximately 5 lbs.) per acre, comprised of at least 160 subsampling points. For rectangular grid cells, the longest dimension should be parallel to the direction of cultivation, and the length of a grid cell should not be greater than $2.5 \times$ the width.

Sampling efficacy improves when the number of sampling points per acre increases and each subsample size reduces, so smaller grid intervals incorporating additional subsamples per acre may be used to achieve greater sampling resolution. Samples may be collected using mechanical or hand sampling with the requirements for each discussed further below.

Sampling Options:

The following two options can be used for full-field sampling on both seed potato and commercial potato fields. The sampling method used will be decided by the state based on staff and resource availability.

1. Mechanical Sampler Survey:

Mechanical samplers include small units towed by all-terrain vehicles, utility task vehicles, or tractor mounted units. Mechanical sampling wheel diameter, number of chisels per wheel, and number of wheels per sampling unit determine the rate of sampling. Calibrate samplers so that at least 2000 cc of soil is collected in at least 160



subsamples per acre to a maximum depth of 4 inches with subsamples being collected uniformly across the length and width of the field.

2. Hand Sampling Survey:

Using a probe or a long-handled trowel, surveyors must sample the entire field in a fixed grid pattern to not exceed a 7×7 pace pattern, with a maximum grid size of approximately 30 m^2 (36 yd^2). Sample the field at a minimum rate of 160 subsampling points/acre, collecting one sample (approximately 1.5 tbsp.) every seven paces, to a depth of approximately 4 inches. If hand sampling immediately following potato harvest, subsamples may be collected from the top 2 inches of the soil profile. The potato harvesting process turns up the soil enough so that representative subsamples are collected from various layers of the soil profile. Refer to [Figure 1](#) for an example survey layout. One 2000 cc composite soil sample should be collected per acre and placed in a properly labeled, double wet-strength paper bag. Please refer to the [Data Management](#) section for sample bag labeling instructions.

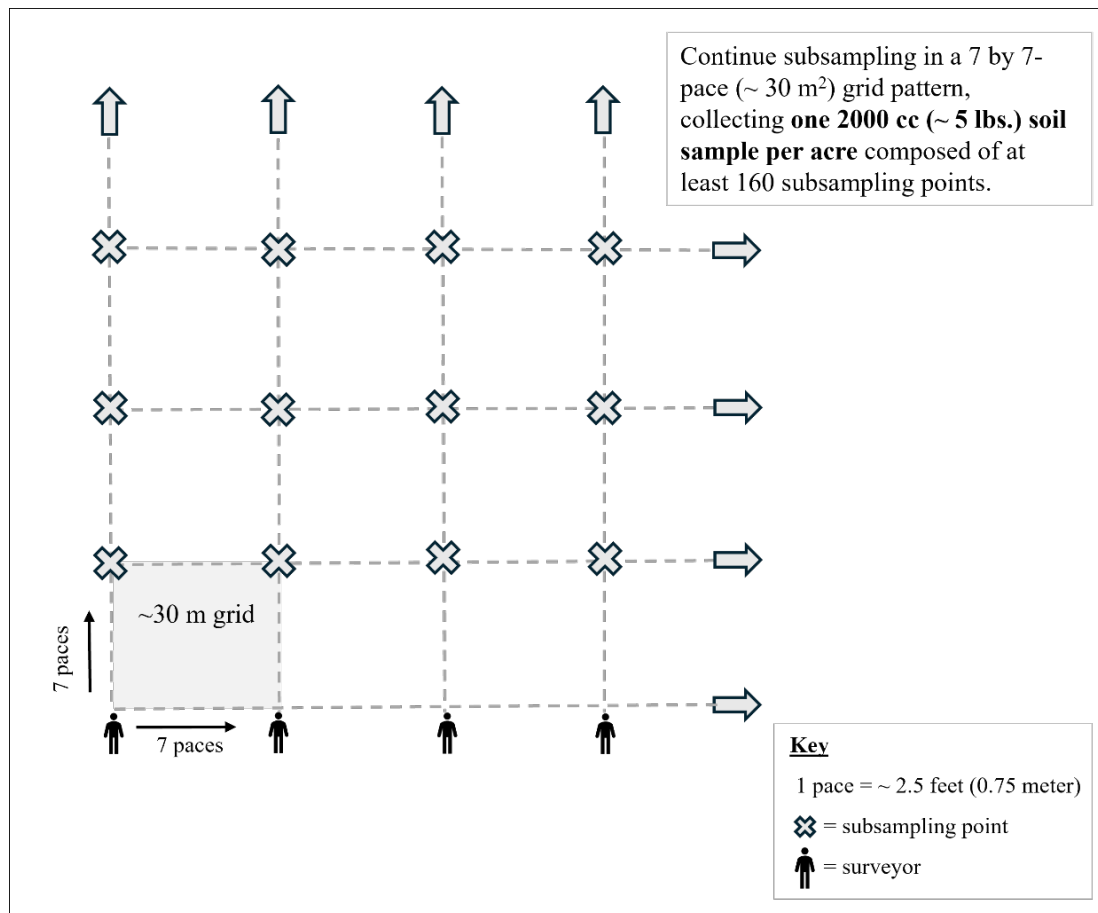


Figure 1. A 7×7 pace (30 m^2 grid pattern) survey diagram.

Further guidance on how to perform the 7×7 pace soil survey is found in Chapter 3 "Survey Steps" in the [Golden Nematode Program Manual](#).

Data Management

It is important to properly identify soil samples as they are taken, and sample identity must be preserved during collection, transportation, drying, and processing. Please refer to the instructions below for sample bag labeling:

Example Sample Bag Label: 26SDFAR-001-001

26 = Year

SD = Submitting State abbreviation

FAR = County Code where sample was taken

001 = Field Number identifier assigned by the regulatory official

001 = Sample Number; note it sequentially increases each time a sample bag is filled from the same field.



The number of bags should be equal or greater to the field acreage. For example, if the field is 60 acres, there should be at least 60 sequentially numbered bags.

Contact the potato cyst nematode [national operations manager](#) for survey data reporting requirements.

References Cited

- EFSA, 2012. EFSA Panel on Plant Health: Scientific Opinion on the risks to plant health posed by European versus non-European populations of the potato cyst nematodes *Globodera pallida* and *Globodera rostochiensis*. European Food Safety Authority Journal, 10(4): 2644.
- NYS-AGM, 2026. Golden Nematode. New York State Agriculture and Markets, New York.
- Sukhanova, A.A., Boyandin, A.N. and Ertiletskaya, N.L., 2022. Potato cyst nematode management strategies: Current situation and promising approaches. American Chemical Society (ACS) Agricultural Science & Technology, 2(3): 415-425.
- Sullivan, M., Inserra, R., Franco, J., Moreno-Leheude, I. and Greco, N., 2007. Potato cyst nematodes: plant host status and their regulatory impact. Nematropica: 193-202.
- USDA-APHIS, 2011. Pale Cyst Nematode (*Globodera pallida*) Eradication Program- Idaho Falls, Idaho, 2011 4th Quarter Report, United States Department of Agriculture, Animal Plant Health Inspection Service, Plant Protection Quarantine.
- Varandas, R., Egas, C. and Conceição, I.L., 2020. Potato cyst nematodes: New solutions to an old problem. Crop Protection, 137: 105303.

Appendix: Specimen Forwarding Protocol

The following protocol describes the procedures, roles, and reporting requirements for screening and confirmatory diagnostic laboratories in support of the Potato Cyst Nematodes National Survey:

- Designated Screening Laboratories
 - a. All soil samples should be shipped to either a PPQ designated laboratory or NPDN laboratory for potato cyst nematode screening. Contact the laboratory before sending shipments for any lab-specific shipping instructions.
 - i. USDA-APHIS-PPQ Laboratories:
 1. Idaho Falls Laboratory:
221 W. Heyrend Way, Idaho Falls, ID 83401
Phone: 208-522-2431
 2. Avoca Laboratory:
8237 Kanona Road, Avoca, NY 14809
Phone: 607-566-7059



- ii. NPDN Laboratories: [Laboratory Directory](#)
- b. All soil samples sent must meet the following identification and packaging requirements:
 - i. Seal each double wet-strength paper sample bag with a double fold at the top and secure with heavy duty staples. Please avoid using standard paper staples.
 - ii. Ensure each bag is labeled with a unique identifying field number as described in the [Data Management](#) section.
 - iii. Allow samples to dry thoroughly (a minimum of 2 weeks) before placing inside shipping boxes. Drying the samples well-spaced apart with forced air is most efficient.
 - iv. Use heavy duty cardboard boxes to ship samples. Do not exceed 40 lbs. per box.
 - v. Ensure samples fit snugly inside the box; do not leave any empty headspace in the box to avoid crushing or ripping boxes during transport. If you cannot eliminate headspace, fill with crumpled paper. Avoid using bubble wrap, packing peanuts, or placing samples inside plastic bags.
 - vi. Create a chain of custody listing all samples that are included in the shipment. Enclose a hard copy of the chain of custody and ensure all required paperwork is enclosed based on the information required by the testing laboratory.
 - vii. Mark the outside of boxes 1 of X, 2 of X, etc. Pack samples in sequential order, with lowest sample IDs in box 1 and highest sample IDs in the last box of the series.
 - viii. Label the outside of boxes with the field identification number and sample range. For example, "26SDFAR-001-001-060."
 - ix. Include only one field per box. If a regulated potato cyst nematode is detected in a box containing samples from multiple fields, all fields may be suspect for potato cyst nematodes, provided there is soil commingling, until further field sampling and analysis can be performed.
 - x. Securely close boxes with packing tape. Tape along all box seams to help prevent soil leakage if the bags inside the box should break open.
- c. Ship soil samples via a traceable commercial carrier to the designated laboratory. There is no need to send the shipments via overnight or express carrier.
- d. If no cysts are found, the designated laboratory should report negative data to the SPHD and SPRO of the state where the survey was conducted.



- Confirmatory Diagnostics
 - a. Designated screening laboratories must forward suspect potato cyst nematode samples to APHIS for confirmatory diagnostics. A suspect sample is a sample that was processed and screened using an approved potato cyst nematode extraction method where cysts displaying *Globodera* species morphological characteristics were identified and retained for confirmatory testing. The overriding principle is that if there is any doubt about the identity of a sample, submit it for confirmatory diagnostics. APHIS confirmatory diagnostics include identification based on cyst morphology and/or testing of DNA isolated from second stage juveniles from eggs from one or more cysts.
 - b. The designated screening laboratory must notify the SPHD of the state where the survey was conducted of any suspect cysts requiring confirmatory diagnostics. Prior to shipping the sample for confirmatory diagnostics, the SPHD will work with the designated screening lab to generate a [Specimen Determination PPQ Form 391](#), and Agriculture Risk Monitoring Diagnostic Request (ARM DR) record. The ARM DR will inform the designated screening laboratory where to send the sample for identification. Include a copy of the PPQ Form 391 and the ARM DR with the shipment.
 - c. APHIS will provide confirmatory diagnostic results to the SPHD and SPRO of the state where the survey was conducted.

Please contact the following National Program Managers for additional information and/or assistance:

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