POTATOES & PESTS

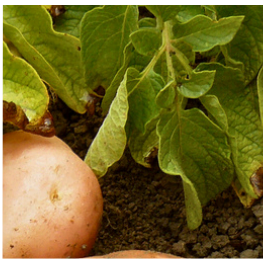
PAPAS

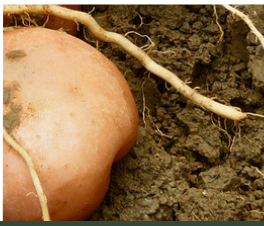
Actionable Science Against Nematodes

2025

Stakeholder Progress Report

Systems Approach to Nematode Control in U.S. Potato Production





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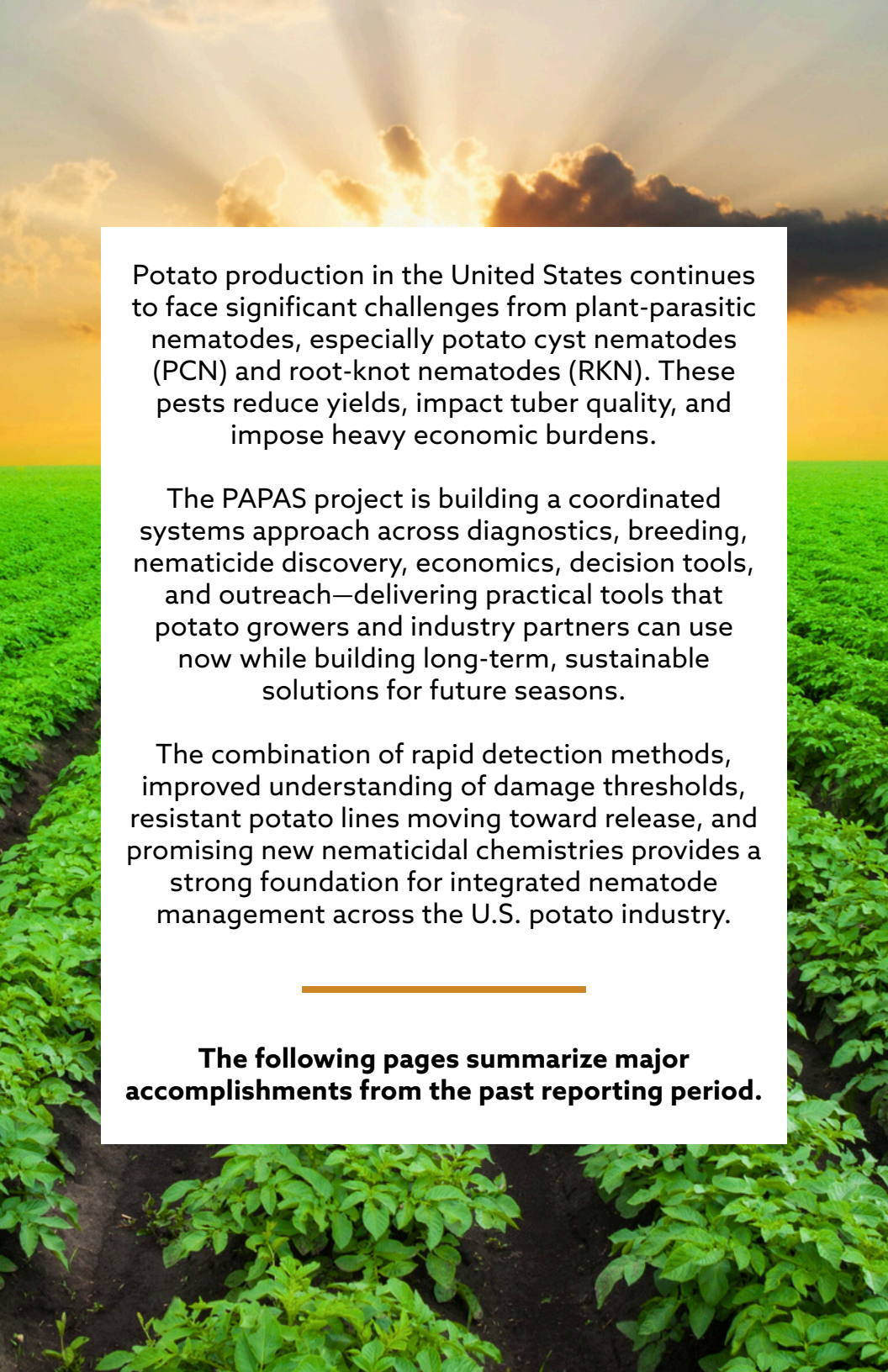
PotatoNematodes.org



Potato production in the United States continues to face significant challenges from plant-parasitic nematodes, especially potato cyst nematodes (PCN) and root-knot nematodes (RKN). These pests reduce yields, impact tuber quality, and impose heavy economic burdens.

The PAPAS project is building a coordinated systems approach across diagnostics, breeding, nematicide discovery, economics, decision tools, and outreach—delivering practical tools that potato growers and industry partners can use now while building long-term, sustainable solutions for future seasons.

The combination of rapid detection methods, improved understanding of damage thresholds, resistant potato lines moving toward release, and promising new nematicidal chemistries provides a strong foundation for integrated nematode management across the U.S. potato industry.

The following pages summarize major accomplishments from the past reporting period.

OBJECTIVE 1

Improving Diagnostics and Decision Support

New tools for faster nematode identification

Accurate identification is essential for managing PCN and RKN, and recent advances in molecular methods are now making this process faster and more accessible. The PAPAS team improved several molecular assays and developed a new LAMP (Loop-Mediated Isothermal Amplification) test specifically for *Globodera pallida*. This test identifies the species in roughly 30 minutes, requires only simple equipment, and is more sensitive than traditional PCR.

A national diagnostic workshop trained 12 researchers and diagnosticians (pictured below) in these emerging tools, strengthening capacity across the country.

Building stronger models for grower decision-making

A major focus this year has been developing decision support systems (DSS) that help growers evaluate nematode risk, yield impacts, and management options. Historical PCN records from USDA-APHIS, combined with new datasets from Idaho and New York, are now being used to build models that predict where nematodes are likely to be found and how best to sample them.

Field research clarifies how nematode pressure translates into yield loss. Multi-year trials showed that *Meloidogyne hapla* and *M. chitwoodi* cause substantial tuber damage in certain varieties—'Ranger Russet' is particularly vulnerable.

Predictive models demonstrated that *G. pallida* can reduce yields by as much as 50% in the susceptible cultivar 'Desirée' and the resistant variety 'Innovator' at high densities (80 eggs/g). Both of these varieties are intolerant of *G. pallida*. Although yield loss due to *G. pallida* for 'Russet Burbank' was considerably less than for both 'Desirée' and 'Innovator,' tubers are much smaller, greatly impacting the quality of tubers. The impact on tuber size will reduce the economic returns for this variety of potato but not necessarily total yield.

Rotations that work—especially with trap crops

Field studies conducted in Idaho evaluating trap crops showed very promising results. *Solanum sisymbriifolium* (litchi tomato) reduced *G. pallida* by up to 100%, and resistant potato varieties prevented nematode reproduction altogether. Quinoa reduced *G. pallida* densities by about 50%. Three-year rotations using these crops achieved near-eradication, offering growers a powerful cultural tool where PCN is present.

OBJECTIVE 2

Developing Potato Varieties with Durable Resistance

Breeding long-lasting nematode resistant potatoes remains one of the most important goals for the industry. This project continues to make major progress on both the genetic and breeding fronts.

Discovering new resistance genes

From *Solanum sisymbriifolium*, six receptor kinase-like genes were introduced into potato. Two consistently reduced nematode reproduction, identifying them as strong candidates for further improvement. In addition, the team cloned a new resistance gene, NILR1, and has identified homologs that may evade degradation by nematode effectors—an important step toward durable resistance.

Breeding pipelines advancing toward variety release

Screening of wild potato species produced a collection of parents resistant to nematodes. These have been incorporated into breeding populations, and two new mapping populations are now being phenotyped to pinpoint nematode resistance genes.

In the 2024–2025 breeding cycles, more than 5,800 clones were evaluated for agronomic traits, with top performers moved to second-year and advanced yield trials. Line A16261-2PCN, which combines strong agronomic performance with PCN resistance, is currently in Advanced Yield Trials and could be released within the next 4–5 years.

For Columbia root-knot nematode, digital tools such as optical grading, AI-based trait detection, and drone canopy imaging are improving selection efficiency.

OBJECTIVE 3

Discovering New Nematicidal Compounds

Alongside breeding, PAPAS is exploring new natural nematicidal chemistries from *S. sisymbriifolium*.

Potent extracts identified

Sequential extraction showed that butanol extracts from *S. sisymbriifolium* had significant activity, reducing PCN hatch by more than 50%. Active fractions were separated and are undergoing chemical identification.

Key compounds show promise

Metabolomics identified more than 2,100 compounds in the roots of *S. sisymbriifolium*, with a subset enriched at levels much higher than in susceptible potatoes. Several compounds—including furoic, aconitic, and quinic acids—were toxic to both PCN and RKN. Root volatiles also inhibited hatch, suggesting multiple modes of action.

These findings support development of novel biorational nematicides that could supplement or replace current chemistries.

OBJECTIVE 4

Outreach to Growers and the Potato Industry

The PAPAS team continues to expand outreach to industry stakeholders. The potatonematodes.org website was updated with new identification resources, management recommendations, and research progress summaries. Fact sheets and blogs reached growers through social media, email lists, and industry events. Graduate students engaged in these efforts, gaining experience in scientific communication.

PotatoNematodes.org

Join us in our effort to create better tools and strategies to fight destructive plant-parasitic nematodes.

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