TECHNICAL NOTE TN30 (Revised) / March 2026

Potato cyst nematodes (PCN)

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Summary

PCN still present a significant threat to the UK's potato industry due to the large yield losses caused and being a hardy and persistent pest. Management of PCN is becoming easier however with better understanding of hygiene requirements, more resistant potato varieties available, new research into cover and trap crops, and the introduction of new technology such as spot sprayers for groundkeeper control and the launch of the decision support system; PCN Scenario planner. Data included in this Technical Note was produced by PCN Action Scotland, a Scottish Government funded project.

Potato Cyst Nematodes (PCN)

Potato Cyst Nematodes *Globodera rostochiensis* and *G. pallida* are one of the most significant threats to both seed and ware potato production. PCN can significantly decrease yields, by up to 80% in some cases, and once present in a field they can remain for 20+ years.

Recent estimations indicate that over a third of Scottish land available for potato production now has PCN present. The high level of PCN infection across Scotland increases the risk of yield loss and complicates future rotation planning.

This publication looks at the PCN life cycle, spread, symptoms in the field and steps for PCN management.

PCN lifecycle and replication

PCN are not a native pest to the UK having originally been brought over on infected tubers from South America in the mid-nineteenth century. *Globodera rostochiensis* (yellow cyst nematode) and *G. pallida* (Pale/white cyst nematode) are named due to the colour of the maturing females prior to the body wall of the cyst turning a reddish brown (Figure 1). Under field conditions, new cysts usually contain approximately 200-300 eggs each. PCN feed on plant species from the Solanaceae family, including potatoes,

Currently in Scotland *G. pallida* is the dominant species found, however *G. rostochiensis* was historically found more frequently. This shift in dominant population was caused through successful use of potato varieties containing the gene H1 which conveys resistance against *G. rostochiensis* (pathotype Ro1). Growing these varieties, such as Maris Piper and Cara, meant that *G. rostochiensis* populations were controlled while *G. pallida* populations were able to multiple unchecked. In recent years resistance genes against pathotypes of *G. pallida* (Pa1 and Pa2/3) have been successfully bred into new potato varieties such as Elland. Dual resistant varieties (resistant to both *G. rostochiensis* and *G. pallida*) are also now commercially available, e.g. Eurostar, Amanda, and Buster.

Figure 1. *Globodera pallida* cysts on potato roots.

PCN Action Scotland

SAC Consulting
Part of Scotland's Rural College (SRUC)

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PCN spread

PCN are spread from field to field through the movement of infected soil. This soil can be transferred on harvested potato crops, machinery, equipment, and footwear which has not been sufficiently cleaned before moving between fields. Depending on the potato varieties grown in infested fields PCN populations can have an increase of at least 50-fold within a rotation (e.g. a susceptible variety grown on light land).

Symptoms in the field

Symptoms of PCN infection manifest as patches of poor, stunted growth (Figure 2). Plants within these patches are usually small and weak with yellowing foliage often observed due to the direct root feeding damage caused by the nematodes. Yield of tubers below patches vary but can be severely impacted by PCN populations. These patches often start relatively small and are often referred to as 'hot spots' in the field, however they can spread quickly with the movement of soil at planting and harvest.

Figure 2. Patch of PCN feeding damage in potato crop. Plants in the foreground are much smaller and struggling to establish canopy coverage compared to unaffected plants in the background.

Groundkeepers or volunteer potatoes emerging throughout the rotation of a field can maintain a PCN population in the absence of a potato crop by acting as safe havens for PCN to continue feeding and replicating.

PCN introduced into a field could be at detectable levels within 4-5 rotations including potatoes. This adds a level of complexity to management as it is not always clear that a field has PCN present until 20+ years after initial infestation occurred.

Implications for seed and ware crops

Under the Seed Potato Classification Scheme (SPCS) administered by the Scottish Government agency SASA (Science and Advice for Scottish Agriculture), growers of seed potatoes must have statutory soil samples taken from intended potato land. A certification that the land has been tested free from PCN must be administered before seed potatoes are planted. If PCN are found, then the land will be scheduled and subject to an official control program for sampled units recorded as infested[1]. Once land has been scheduled a grower is prohibited from re-entering scheduled land for seed potato growing for a minimum of six years. If the PCN population is managed, it is possible for a field to be de-scheduled if it receives a negative PCN test in the future.

[1]. Additional information on PCN testing under the SPCS Scheme can be found at https://www.sasa.gov.uk/pcn-soil-testing-documents

Ware potato crops are not subject to statutory testing; however, it is still best practice to test for PCN before planting. Depending on the variety grown and the PCN population size present at planting the yield observed can be reduced to 80%. For example, with a starting population of 20 eggs/larvae per gram of soil of *G. pallida*, a loss of 25% could be expected in a Maris Piper crop, equaling a loss of 13.75 T/Ha from a 55 T/Ha crop if no nematicides are applied[2].

Steps for PCN management

- Testing your land
- Hygiene best practice
- Assess other crops in rotation – risk and cover crops
- Extend rotation around potatoes
- Control of groundkeepers
- Plant resistant varieties

Soil testing for PCN

Testing soil ahead of potatoes is the best way to assess the potential risk to yield and implement management practices. Broadly, a PCN soil test will provide the number of PCN cysts found, which will tell you if PCN is present in that block of land sampled. Depending on where you get your soil tests performed (SASA, Scottish Government for seed, Commercial labs such as SRUC/Eurofins) speciation and viability testing can also be performed.

Speciation, knowing which species are present in a field, is one of the key pieces of information required for PCN management. The use of resistant potato varieties remains the most effective method for limiting PCN population increase, however many varieties only have resistance to one species. Planting a variety resistant to *G. rostochiensis* in a field predominantly infested with *G. pallida*, for example, will not suppress the existing population and may instead allow it to increase. Without speciation, a standard PCN soil test provides only partial insight, leaving growers uncertain whether their chosen variety will effectively manage the PCN population present or inadvertently contribute to its increase. The only way to combat this uncertainty is to plant a dual resistant variety.

Cysts are often described as being viable, meaning that the eggs present inside are alive and waiting on the correct conditions (e.g. presence of a host plant) to induce hatching. As cysts age in field there is a level of natural decline each year (approximately 20%) meaning that cysts in fields with historic PCN infections may have low to no alive eggs left inside depending on environmental factors. This means that basic cyst count is not enough to determine risk to future crops as number of live nematodes inside are variable. Viability testing sees cysts broken open to assess live egg/larvae counts.

A worked example:

Sample	Total cysts	Viable cysts	Eggs/larvae per gram of soil
A	100	3	4
B	50	46	63

Above are two soil samples for PCN testing. Sample A may look like a higher risk field as it has a higher number of total cysts, however through viability testing it was shown that this sample has a much lower number of live eggs inside. This means that the field where sample B was collected from is at a higher risk for yield loss than sample A.

Hygiene best practice

As outlined above, PCN is spread through the movement of infected soil. Maintaining high hygiene standards such as removing all excess soil from machinery and equipment between fields is vital. If you have fields in rotation with a known PCN infestation, then work in those areas last to avoid moving soil to other clean fields. Planting classified seed potatoes ensures that you are starting with a clean stock, avoiding introducing PCN from infected mother tubers.

[2] Yield loss examples can be calculated using the PCN Scenario planner - https://pcn-dss-dev.koresolution.com

Assessing other crops in the rotation

Planting and harvesting any crop which involves moving large volumes of soil will increase the risk of PCN spread. Crops such as carrots and sugar beet result in soil disruption and movement on machinery and equipment meaning PCN present in these fields are at a high risk for being moved within and between fields.

On the other hand, some crops will reduce the risk of PCN so can be included as part of an integrated pest management (IPM) program. Cover crops such as oil radish and mustard act as biofumigants by producing toxic compounds. Glucosinolates are broken down into toxic isothiocyanates in the soil which kill live PCN juveniles in the soil. Planting such crops around the potatoes in rotation can help reduce PCN populations in the soil[3]. Recently, studies have shown that not all oil radish varieties have the same impact on PCN populations due to differing levels of glucosinolates produced and seed rates used at planting. Data from PCN Action Scotland trials has shown that the oil radish variety Bento (sown at a high seed rate of 36 kg per hectare) produced the largest decrease in detectable PCN juvenile populations (Figure 3).

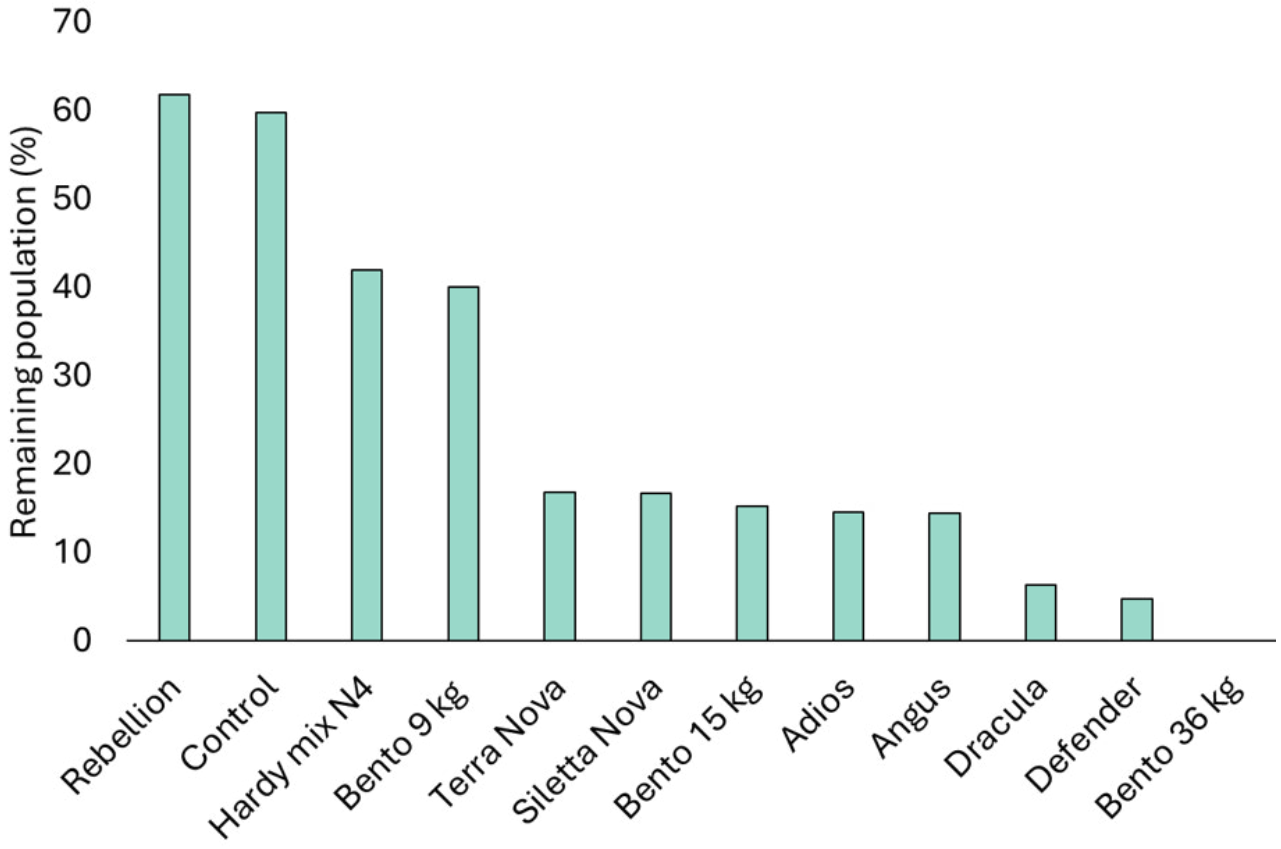

Figure 3. *Globodera spp*. juvenile population change inferred from relative number of detectable 18S sequences before and after different oil radish crops. Results taken from the report "Oil radish variety trials for management of potato cyst nematodes through soil biofumigation in Scotland" which can be found on www.PCNhub.ac.uk

Length of rotations

The longer a field with PCN is left without a potato crop planted, the greater the natural decline in the population. This means that there will be a lower starting population present when potatoes are planted, leading to less feeding damage and subsequent lower yield loss. For seed potatoes SASA recommends a minimum 6-year rotation. There are no legal specifications on rotation length of ware crops, however a minimum of 6 years as standard is good practice. Short rotations (e.g. 4 years) are not recommended for fields with a known PCN population.

[3] Data on oil radish cover crops against PCN can be found at https://www.pcnhub.ac.uk/

Another choice for future PCN management is the DeCyst™ line of trap crops, DeCyst-Prickly - *Solanum sisymbriifolium* and DeCyst-Broadleaf - *Solanum scabrum*[4]. These plant species are close relatives of the potato and cause PCN to hatch. However, PCN cannot complete their life cycle on DeCyst crops. DeCyst crops do not produce tubers like potatoes. Instead, they reproduce by seeds harvested from berries produced by the plant above ground (Figure 4). Research between Greenvale, Produce Solutions, and Harper Adams University report that DeCyst crops can reduce PCN populations by up to 80%.

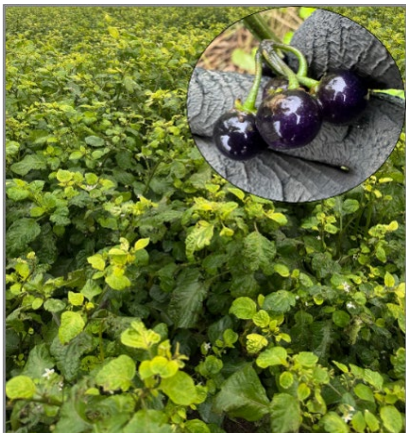

Figure 4. DeCyst-Broadleaf crop in Scotland November 2025. Inset picture of berries produced by crop containing seed.

Control of groundkeepers (volunteers)

Groundkeepers provide PCN with a host to complete their lifecycle in the absence of potato crops. It is important to control recurring groundkeepers regardless of whether they are on owned or rented land. Historically, groundkeepers used to be managed by winter frosts, however, these frosts are becoming shorter and penetrate the soil less, resulting in this being an unreliable management method.

A common problem with groundkeepers is how to target them without damage to the surrounding crop. To tackle this problem there have been recent developments in spot spraying technology. AI trained camera systems mounted to the back of spraying equipment can identify groundkeepers within other crops (e.g. broccoli) and initiate direct spraying (Figure 5). Future investments in this technology on farms will actively reduce the volume of herbicide required and time taken to control groundkeepers in the future. SoilEssentials comparison studies report a reduction in product of between 80-90% using the spot spraying technology when compared to traditional blanket spraying of crops.

Figure 5. Skai Spot Sprayer mounted to the front of a tractor.

Resistant varieties

Resistance against PCN is scored on a 2-9 scale in the UK, with 2 being the most susceptible and 9 being the most resistant. Susceptible varieties (2) will increase the PCN population in a field when planted, partially resistant varieties (3-6) increase the PCN populations, but at a slower rate than susceptible varieties, and resistant varieties (7-9) will reduce PCN populations if planted (Figure 6).

The varieties listed in Table 1 reduce *G. rostochiensis* and/or *G. pallida* infestations effectively, all scoring between 7 – 9. Partially resistant varieties scoring 3 – 6 are available, however, these have not been included below as there is a wide variation in their influence on PCN population sizes.

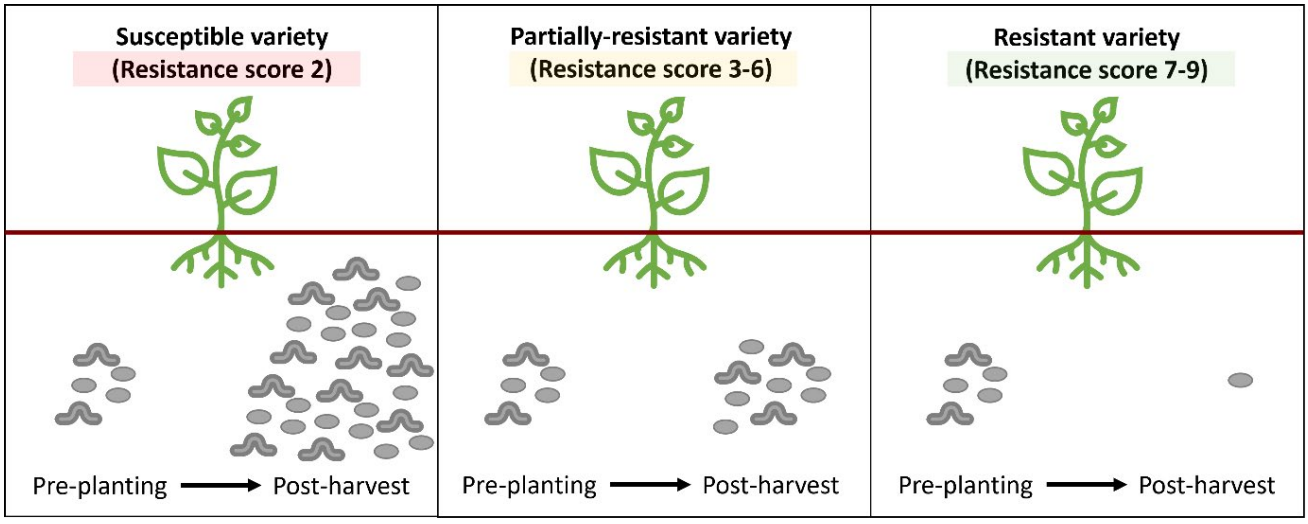

Figure 6. Effect of resistance of potato varieties on PCN populations in soil based on 1 rotation of growth.

[4]. More information on DeCyst products can be found on the Greenvale/Produce Solutions website https://www.greenvale.co.uk/producesolutions/

[5]. More information about the SKAi spot spraying system can be found at https://soilessentials.com/skai-spot-spraying/

Table 1. PCN resistant potato varieties

Resistant to *G. rostochiensis*	Resistant to *G. pallida*	Resistant to both PCN species (Dual resistance)
Atlantic (9) Cara (9) Maris Piper (9) Sagitta (8) Royal (9) Taurus (8)	Elland (9) Innovator (8) Paradox (8)	Amanda (9, 9) Buster (9, 9) Drizella (9, 7) Eurostar (9, 9) Karelia (9, 8) King Russet (9, 9)

Resistance scores for respective PCN species are in brackets. For dual resistant varieties resistance scores in brackets are for *G. rostochiensis* first, followed by *G. pallida.* This is not an exhaustive list of resistant varieties. More information can be found on the national varieties database: https://potatoes.agricrops.org/

Decision support systems

Management of PCN increasingly relies on:

- Resistant varieties
- Informed rotations
- IPM strategies
- Digital decision support tools, such as the PCN Scenario Planner (PCN SP)[6].

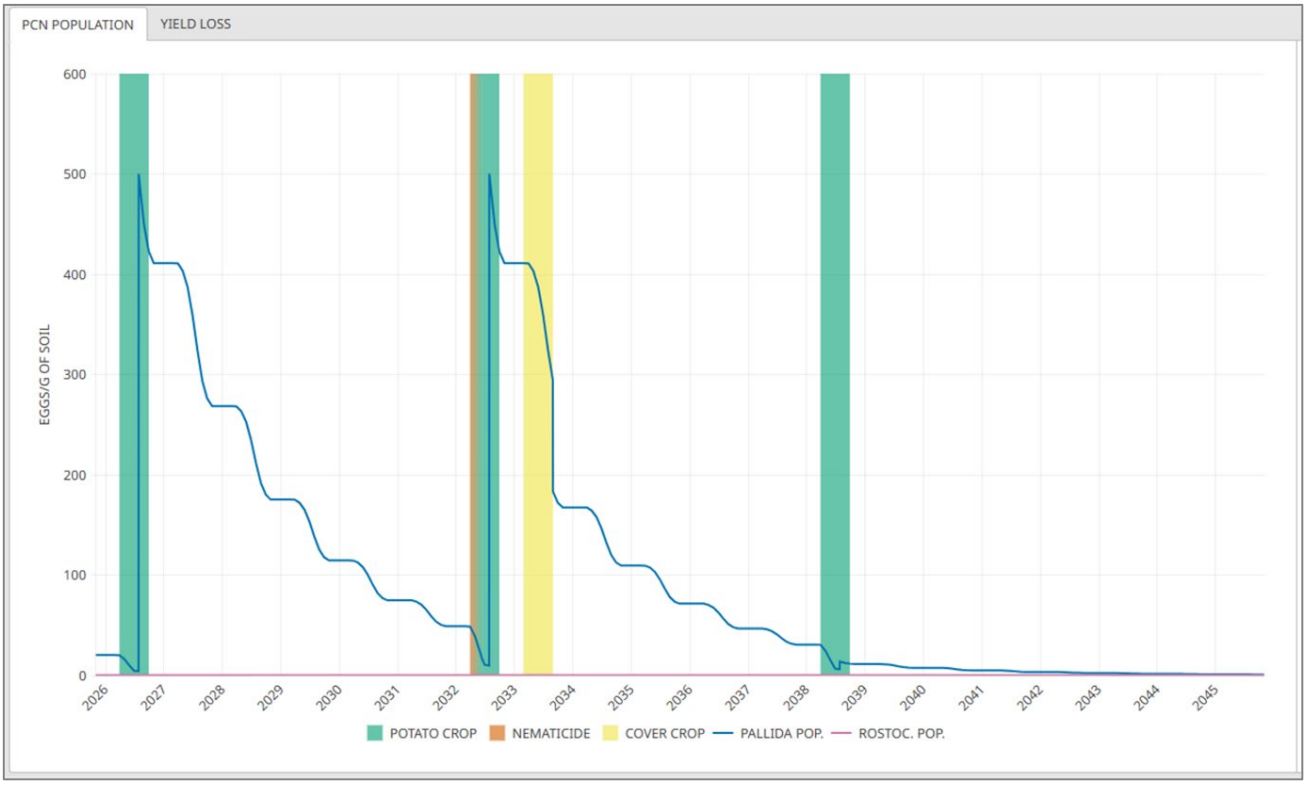

Figure 7. Example from PCN-SP depicting the effect of growing susceptible versus resistant potato varieties and an oil radish cover crop on a G. pallida population.

The PCN-SP developed by SoilEssentials as part of the PCN Action Scotland project was launched in November 2025. The PCN SP is a free, online tool that integrates field data and modelling to help growers and agronomists assess the impact of variety choice, nematicide use, and cover crops on PCN populations and yield outcomes at field level (Figure 7).

[6] The PCN Scenario Planner can be accessed for free by registering at https://dss.pcnhub.ac.uk/

Chemical control

At time of writing (March 2026), there are only two commercial products approved for use in the UK as nematicides; Nemathorin 10G (a.i. - Fosthiazate, Syngenta Ltd) and Velum Prime (a.i. - Fluopyram, Bayer CropScience Ltd)[7]. Both products are used to protect yield in potato crops planted in fields with PCN populations (Figure 8). Nematicides act to kill PCN, however depending on dosage they can also have non-lethal and reversible effects including paralyzing the nematodes long enough for the potato crops to grow and establish before enduring PCN feeding damage[8].

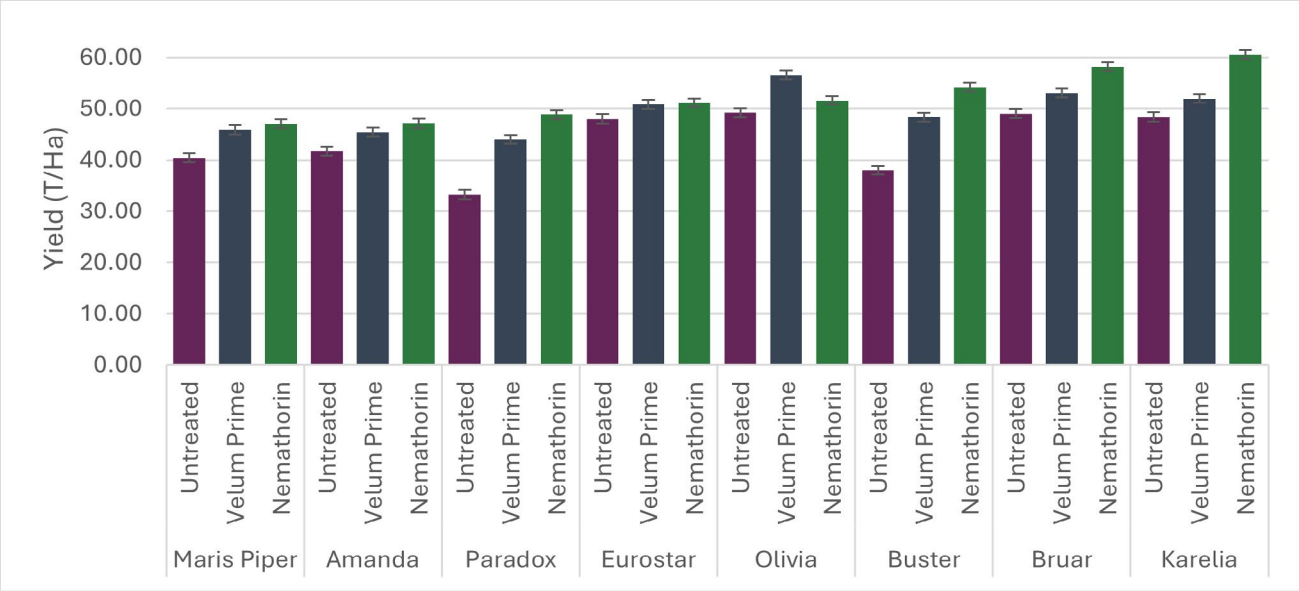

Figure 8. Comparison of yield (Tonnes per Hectare) of 8 potato varieties treated with Velum Prime and Nemathorin in the PCN Action Scotland field trial in Angus, Scotland 2024. The field trial site had an established *G. pallida* population (avg. 30 eggs per gram of soil). Error bars – Standard Error.

Both Nemathorin and Velum Prime slow the increase in PCN populations when compared to untreated controls. However, there is still an overall population increase when planting a susceptible variety (Figure 9).

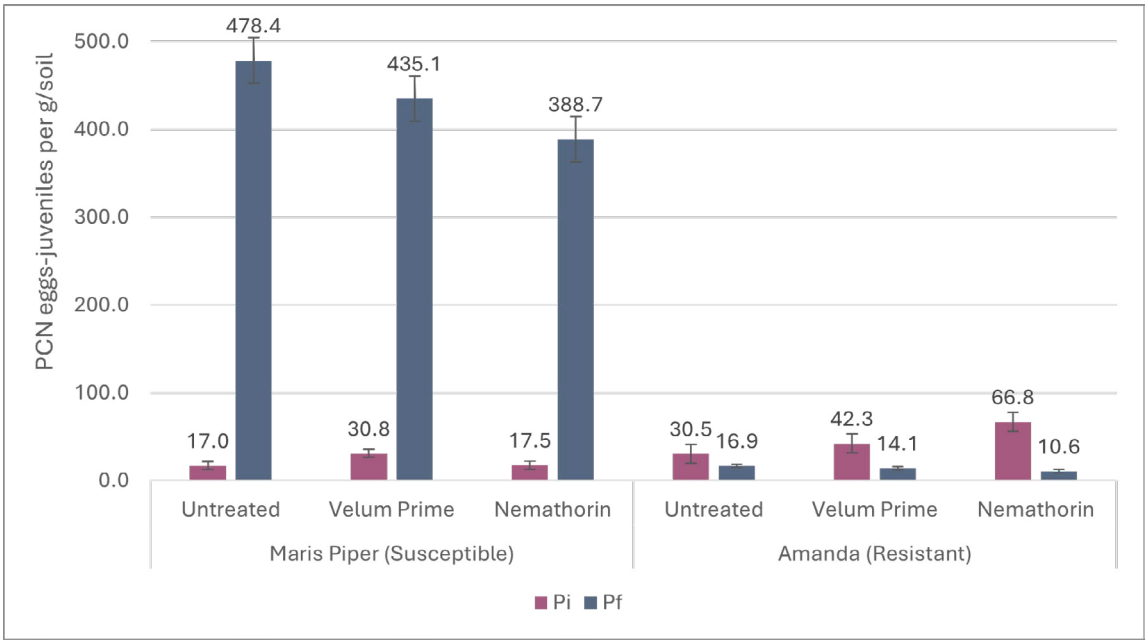

Figure 9. *G. pallida* population changes between pre-planting (Pi) and post-harvest (Pf) soil sampling from field trial in Angus, Scotland 2024. This example includes Maris Piper as a variety susceptible to *G. pallida* and Amanda as a resistant variety. Results of nematicides will vary with varieties. Error bars – Standard Error.

In Figure 9 when Maris Piper (susceptible to *G. pallida*) was planted, the PCN population increased 28.1-fold in the absence of nematicide treatment. Applications of Velum Prime and Nemathorin saw reductions of 43.3 and 89.7 eggs/juveniles per gram of soil respectively when compared to the untreated control plots for this trial. This can be compared to the resistant variety Amanda, which saw decreases in the PCN population in plots for untreated, Velum Prime, and Nemathorin. While Velum Prime and Nemathorin are contributing to this population decrease, it is the resistance genes present in the variety Amanda that causes most of this reduction. It should be noted that the data in Figures 8 and 9 are from a single field trial. Results of nematicide use will vary dependent on potato variety and environmental factors.

A third nematicide product line available for use in the UK is Nemguard® PCN, granules this product line offers a more natural alternative, with its active ingredient comprising a high concentration (45%) of garlic extract (Certis Belshim). Alternatively garlic extract for use against PCN is also available in a high concentration, liquid formulation in the product Velsinum (Bayer CropScience Ltd).

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