Technical Note TN631

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Potato Tuber Pests

SUMMARY

- **Identification and integrated control of tuber pests.**

Soil potato pests

There are a variety of pests that feed below the soil surface on potato roots and tubers. Most of these pests can be detected and population estimates obtained prior to planting and managed through the use of resistant cultivars and pesticide use.

Nematodes

Potato Cyst Nematodes

There are two species of potato cyst nematode (PCN) present in the UK: *Globodera rostochiensis* and *Globodera pallida*. Both species feed on the roots of the crop, hatching from cysts in the soil in response to chemicals given off by potato roots. This leads to stunting of growth, yellowing of foliage and subsequent lowering of yield (Fig. 1).

Fig. 1: Symptoms of PCN damage in the crop

Cysts can usually be seen on the roots of the growing crop from July onwards (Fig. 2). *G. rostochiensis* is the most common species, and easiest to manage by the use of resistant cultivars such as Maris Piper and Cara which disrupt the life cycle of the nematode and prevent an increase in population size. There has been selection for *G. pallida* ahead of *G. rostochiensis* due to the planting of *G. rostochiensis* resistant cultivars. Consequently the levels of *G. pallida* have increased

Fig. 2: PCN cysts visible on the roots

significantly over the last 20 years or so. *G. pallida* is more difficult to manage as there are no fully resistant cultivars available that will prevent its multiplication in soil. Viable PCN cysts can persist in the absence of potatoes for 15 years or more, and whilst there is some spontaneous hatching of cysts each season, PCN decline to below damaging levels can take several years.

In Scottish soil samples tested by SAC for the presence of PCN in 2008/2009, 25% had PCN present, with 46% of those PCN positive fields having *G. rostochiensis* alone, 28% having *G. pallida* alone, and 26% of positive fields having both PCN species present.

Seed potatoes cannot be grown in fields where PCN is present, so the slow shift from *G. rostochiensis* to the harder to manage *G. pallida* in Scottish soils is a threat to the Scottish seed potato industry.

Potato cyst nematodes are a problem throughout Europe and a new European Union Directive on the control of Potato Cyst Nematode (2007/33/EC) will come into force from 1st July 2010. There are implications for growers of seed and ware potatoes which are summarised below. Legislation to implement the new regime will be laid before the Scottish Parliament in spring 2010, at which point detailed guidance will be issued to growers. Fees are being introduced to cover the additional costs of the new system.

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Land will still need to be tested for the presence of PCN in order to grow seed potatoes, with one new factor being that fields destined for farm-saved seed will also need to have a statutory PCN test, unless the seed is to be planted at the same place of production (i.e. the same holding). Farm-saved seed grown on untested land cannot be moved and planted 'off-farm'.

Seed growers can define how a field is to be divided into "sampled units" (min size 4 ha). Using larger sampled units will reduce the amount of soil to be taken, and therefore the fees but if PCN is found, the whole sampled unit will be classed as infested with PCN and subject to restrictions.

As part of the PCN directive 0.5% of ware potato land will also be randomly selected each year for a post-harvest PCN test (approximately 16 fields in Scotland).

If PCN is found, either in pre-planting tests for seed or in the ware survey, no seed potatoes can be grown in that sampled unit. Ware potatoes can be grown under an officially approved control programme.

The aim of this official control programme is to suppress PCN populations in ware land, and will primarily be based on current 'best practice': i.e. use of rotations, resistant cultivars, and nematicide. Growers may wish to use the Potato Council PCN model (which will be updated over the next two seasons or so) to help them decide the best combination of methods. This control programme has to be submitted to Scottish Government for approval; they must be satisfied that the measures to be undertaken will suppress the PCN in that field prior to growing subsequent potato crops in the rotation.

The rationale behind the new PCN directive is to prevent the spread of PCN into 'clean' land, and to suppress the populations of PCN that we already have in ware land.
Management of PCN relies on knowing what species of PCN is present. This is particularly important if renting land for ware production. Soil sampling and testing soil for the species and population size of PCN is strongly recommended, as this can influence choice of cultivar and whether the population of PCN will reduce yield. Note that even if only *G. rostochiensis* is present and a resistant cultivar is to be planted, yield loss can still occur if PCN populations are above 10 eggs or juveniles/g soil, as the resistance is expressed by a reduction in PCN multiplication, not in preventing feeding.

A long-term view needs to be taken to provide effective management of PCN. Long rotations with 5-6 years minimum between growing potato crops in infested land is recommended, with informed use of resistant cultivars and nematicides, especially when dealing with G. pallida infested land. Nematicides need to be broadcast prior to planting, and currently the available products are Vydate (oxamyl), Nemathorin (fosthiazate) and Mocap (ethoprophos).

Free living nematodes

These are nematodes that live in the soil and can feed on a wide range of plants including weeds. They were covered in detail in a previous Technical Note (TN603: Soil Dwelling Free-Living Nematodes as Pests of Crops). The three main groups of nematodes that affect potatoes are the needle nematodes (*Longidorus* spp), the stubby-root nematodes (*Trichodorus* and *Paratrichodorus* spp) and the root-lesion nematodes (*Pratylenchus* spp). The needle nematodes and stubby-root nematodes feed externally on the roots and root hairs, whereas root-lesion nematodes will also feed internally within the roots. The damage that nematodes cause to plants increases with the numbers of nematodes present, however there may be other organisms that invade the feeding lesions caused by nematodes (e.g. bacteria and fungi) that can exacerbate the damage produced by nematodes.

Nematodes feeding on potato roots increase root biomass at the expense of top growth at low populations (Fig. 3).

Fig. 3: Free living nematode damage to plants - Nematicide protected (left), unprotected (right)

Fig. 4: Poor emergence due to free living nematode damage. Nematicide protected on the left, unprotected on the right

At higher nematode populations root biomass is reduced, as is yield. Tuber initiation is delayed, and fewer tubers produced. The size fractions of tubers are also affected with less uniformity in the size range of tubers, leading to more outgrades and consequently a reduction in the marketable yield. Reductions in marketable yield by as much as 50% have been seen in SAC field trials. There may also be effects on fry quality and sugar content, which areimportant for potatoes destined for processing.

Nematode populations detected in soil have increased significantly over the last 15 years or so, with stubby-root nematodes and root-lesion nematodes increasing by up to 300% compared to numbers in the mid-1990's.

Stubby-root nematodes have the additional threat of being vectors for tobacco rattle virus (TRV) where lower population levels may cause severe crop losses due to "spraing" symptoms (Fig. 5).

Fig. 5: Spraing symptoms due to TRV infection of tubers

Over the last few seasons, soil samples submitted to SAC from ware potato growers for assessment for the presence or absence of TRV has have consistently resulted in around 30% of samples testing positive for TRV.

Control

Management of free living nematodes in soil is challenging as they can feed on a wide range of plants and build up their numbers on crops and weeds in the period between potato crops. They will also cause damage to other crops as well, with effects on cereals becoming noticeable in recent years, as well as the damage they cause to root crops such as carrots, parsnips and onions.

Obtaining an estimate of the population of free living nematodes in soil pre-planting is essential, as is determining whether stubby-root nematodes are carrying TRV. If populations are high, then there is a threat of feeding damage (and/or TRV), so the crop will need protecting through the use of a nematicide treatment. Vydate (oxamyl), Nemathorin (fosthiazate) and Mocap (ethoprophos) can be applied as a broadcast treatment prior to planting, or Vydate can be used as an in-furrow treatment.

These treatments will protect the crop from root damage and TRV, but because they do not directly kill the nematode, only paralyse it until the concentration of the active ingredient declines and the nematodes 'wake up', use of these nematicides does not significantly reduce the nematode population in the soil.

Wireworm

Wireworms are the larvae of click beetles, of which there are several species in the UK. Depending on the species, the larvae take 3-5 years to complete their life-cycle. Typically click beetles lay their eggs in grass, so crops to be planted when there has been grass in the rotation (particularly long-term grass) are more likely to have wireworm present. However, there is increasing evidence that wireworm are also being found where there has not been grass in the rotation: set-aside will have increased the risk from wireworm as will the presence of grassy stubble.

The larvae feed on the roots and tubers of potatoes, having a significant impact on tuber quality (Fig. 6).

Fig. 6: Wireworm damage to potato tubers

There tends to be a zero tolerance for wireworm damage by potato processors and supermarkets, consequently wireworm management often resorts to 'don't plant potatoes in fields where wireworm are present'. However, there are several management options open to growers to reduce the threat from wireworm.

Because of the long life-cycle of the wireworm, their presence in soil can be determined 1-2 seasons before potatoes are to be planted. Soil samples can be taken (preferably from grass) and wireworm presence/absence detected with an estimate of the population size obtained. Increasingly bait trapping is used to detect wireworm in the soil. Abait trap could be a plastic container with holes in the side which is filled with a mixture of cereal seed and bran (available from some pesticide distributors) and buried in the soil, or burying some potatoes and assessing them for wireworm damage. For either bait trap to give valid assessments of wireworm presence, they need to be buried to a depth of around 15cm, and when soil temperatures exceed 4ºC or more. Ideally bait traps should be used in the early autumn (Sept-Oct) or early spring (late Feb-March), but is very dependant on the soil temperature. Traps need to be left for 2-3 weeks to allow wireworm to feed. Either approach requires the trap and soil immediately surrounding the trap to be assessed for the presence of wireworm as well as looking for wireworm damage to the potato or wireworm presence in the trap.

An alternative approach is to use pheromone traps to detect click beetles emerging from the soil in the field the season before potatoes are to be planted. The pheromone trap needs to be in place from May to August which is when the beetles emerge from the soil. The more beetles that are caught, the more likely there is a residual population of wireworm in that field.

Control

If there is a threat from wireworm, and there is no opportunity to change fields, then the options open to the grower are choice of a less susceptible cultivar, use of an insecticide and early lifting.

Some potato cultivars are less proneto damage than others, but it should be noted that there are no potato cultivars resistant to wireworm damage; damage is less in some cultivars than others. Cultivars least susceptible to damage include Pentland Dell, Maris Piper, Nadine and

Harmony. Cultivars most susceptible to damage include Maris Peer, Marfona, Cara and Rooster.

Insecticide choices are Mocap (ethoprophos) and Nemathorin (fosthiazate) which need to be broadcast prior to planting, but it should be borne in mind that these will only reduce wireworm damage to some extent.

Test digs should be undertaken from early August to see if wireworm damage is occurring. If so, then crops should be lifted as soon as practically possible, as the longer potatoes are in the ground, the greater the damage will become.

Options to try and reduce wireworm populations in the soil range from soil cultivation in the autumn and/or spring to allow birds to feed on the exposed wireworm, or the use of an insecticide seed treatment on preceding cereal crops such as Austral Plus (tefluthrin) or the Deter range of seed treatments (clothianidin).

Slugs

Slug damage to potatoes is particularly noticeable (Fig. 7).

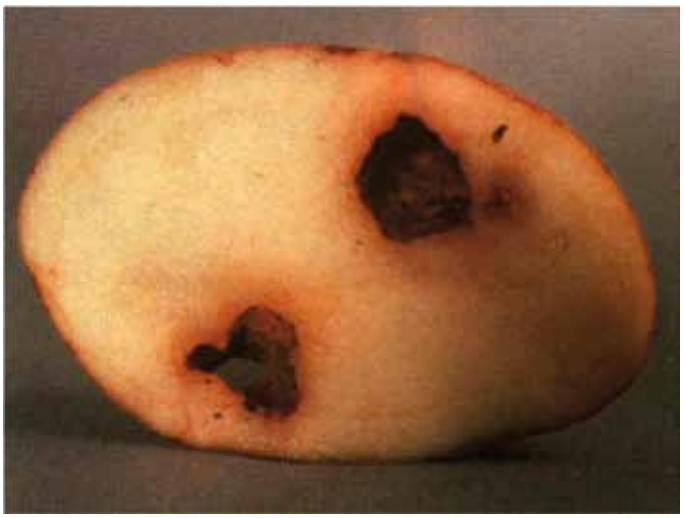

Fig. 7: Slug damage to potato tubers

Of the several species of slugs found in arable soil, some are more damaging to potatoes than others. The most common slug species seen is the grey field slug (*Deroceras reticulatum*), however this slug prefers to feed on tubers already damaged by other pests or disease. The slugs that particularly target potato tubers are the keeled slug (*Tandonia* spp) and the garden slug (*Arion hortensis*).

Lower slug populations are needed for damage to potatoes than for damage to cereals, and slugs tend to attack damaged tubers in preference to undamaged. Slug damage can continue in potato stores if slugs have been lifted with the crop.

Most growers will be aware of 'sluggy' fields or areas within fields perennially prone to slug problems, and slug management can start in the previous crop by reducing the population of adult breeding slugs by creating fine seed beds, consolidated by rolling the areas particularly prone to slug damage. Use of slug pellets in the preceding autumn on crop stubble can also reduce slug populations to some extent by targeting slugs prior to breeding, consequently reducing the numbers of eggs hatching the following spring.

Slug monitoring through the use of baited traps can gauge the threat from slugs prior to planting and throughout the season.

As with wireworm, some potato cultivars are less susceptible to slug damage than others, but if slugs are hungry they will still damage these less susceptible cultivars. Cultivars such as Pentland Dell, Lady Rosetta and Hermes are less susceptible to slug damage than the very susceptible cultivars Maris Piper, Cara and Saxon. If slug damage is seen when carrying out test digs, then crops should be lifted as soon as possible. In trials a Maris Piper crop lifted on 8th August had 10% of tubers damage, when lifted on 3rd October had 30% damaged, and lifted in early November had 45% damaged.

Control

If there is a risk of slug damage, gauged by previous experience and/or slug trapping, then slug pellets can be applied but the timing of these treatments is crucial for their success. Trials have consistently demonstrated that at least at least 2 full-rate pellet treatments are needed to protect tubers from slug damage. The most important timing for slug pellet application is just before the crop canopies meet across the rows. If this timing is missed then regardless of how many applications are made, slug damage will still occur. This timing is crucial as slugs will come up onto the soil surface once the crop canopies meet, as the humidity under the crop draws slugs up onto the surface. If there are slug pellets there waiting for the slugs then an elevated level of control can be obtained. Once crop canopies have met it is more difficult to get the pellets to the base of the plants.

Slug pellets are available with the following active ingredients: methiocarb, metaldehyde and ferric phosphate.

A novel approach to slug management in potatoes (including organic crops) is the use of a slug-specific pathogenic nematode which actively seeks out soil-dwelling slugs. These are available as Nemaslug Xtra and have to be watered into soil during the season. A programme of 2-3 applications has been shown to be very effective, and can also be used in conjunction with slug pellets in an integrated management programme.

Symphilids

Over the last few years some crops in Scotland and a few in England on light land have had poor emergence with plants having stunted roots, with distinct dark lesions which have allowed fungal rots to take hold. Close examination of the soil reveals the presence of small (1-9mm) white insects with 6-12 pairs of legs, which resemble tiny millipedes. These are symphilids.

Because of their size, symphilids are difficult to detect in the soil, and it is only after the damage has been noticed does thought usually turn to symphilids as being the culprits. The 'bucket of water' test can usually detect them; dip the roots of damaged plants in a bucket of water and shake about, remove and wait a few minutes. The small, white symphilids will float up to the soil surface and will still usually be wriggling around. Other small, white insects called springtails may also be present. Springtails only have 3 pairs of legs, whereas symphilids have 6-12 pairs. Large populations of springtails need to be present to cause damage to potatoes, but 2-3 symphilids per plant may be enough to damage potato roots under the right conditions.

Symphilids move up and down the soil profile depending on the moisture content, as they dislike the dry conditions near the soil surface.

They can live for several years and population levels may reach about 100 to 600 individuals per square metre.

It is difficult to obtain an accurate assessment of symphilid numbers before sowing, as they will still be relatively deep down in the soil.

Control

To try and minimise any problems due to feeding by symphilids, avoid planting tubers in cold, wet soils where emergence may be prolonged and allow greater time for damage to occur pre-emergence. As there may be other causes of poor emergence such as free living nematodes, dry rot and skin spot, ensure that correct diagnosis of the problem is obtained.

Pesticides applied for control of PCN, free living nematodes and wireworm will have a positive effect against symphilids.

Cutworm

Cutworms are the larvae of turnip moth and heart-and dart moths which lay their eggs on the lower leaves of potatoes and other vegetable crops. The caterpillars initially cause superficial damage to the older leaves of potato but then drop down to the soil and feed at or just below the soil surface where they can chew their way through the stem of the plant. The presence of cutworms will only be noted at night when they come to the soil surface to feed.

The egg-laying moths prefer weedy crops so good weed control will reduce the likelihood of a cutworm problem. Also young cutworms cannot survive in wet soils so irrigation or rainfall at the time of egg hatch will kill off a lot of young larvae.

Control

A cutworm spray warning is issued each year based on the trapping of moths in pheromone traps. The young larvae initially feed on the lower leaves and so are vulnerable for a short time to foliar sprays. However if the spray warning coincides with wet weather, then no chemical treatment will be needed.

Sprays of chlorpyrifos (e.g. Dursban, Ballad), cypermethrin (e.g. Toppel 100 EC), lambda-cyhalothrin + pirimicarb (e.g. Dovetail, Mortice) or zeta-cypermethrin (e.g. Fury 10 EW) can be applied as soon as the spray warning is issued. Seed potato crops tend to be more at risk than ware.

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