



CONTROL OF POTATO CYST NEMATODES

OFFICIAL CONTROL PROGRAMME FOR SAMPLED UNITS RECORDED AS INFESTED

Guidance for Growers and Landowners

1. Under the new PCN legislation (which came into force on 1 July 2010), if PCN are found in an official PCN soil test the sampled unit¹ will be **recorded as infested** (this is equivalent to Scheduling under the previous PCN regime). On this sampled unit,

- **No seed potatoes** may be produced, either for classification or for farm saved seed;
- Ware potatoes may be grown, but only if an officially approved control programme is in place to suppress PCN and minimise the risk of spreading the pest.

2. This leaflet sets out the procedures for recording the unit as infested and setting up a control programme for growing ware, or reducing the level of PCN so that it can be used for seed again.

Recording

3. When a positive result is obtained from an official PCN soil test, carried out by the Scottish Government, the sampled unit will be recorded as infested in the official records. A Statutory Notice under the Plant Health (Scotland) Order 2005 will be served:-

- on the person who applied for the test, in the case of tests carried out for growing classified or farm saved seed;
- on the person who grew potatoes on that unit, in the case of tests carried out for the ware survey; and
- on the owner of the land, in both cases.

4. The Notice will state that it is an offence:-

- To grow or permit to be grown on that land any potatoes intended for replanting (classified seed or farm saved seed);
- To grow or permit to be grown on that land any plant listed in Annex 1 of the Directive (see Annex 1) intended for replanting, unless it is to be marketed practically free of soil;
- To grow or permit to be grown on that land any potatoes intended for consumption (ware) except in accordance with an official programme for control of PCN approved by the Scottish Government.

If the test was carried out for the ware survey, the Notice will also set out the restrictions on any potatoes from that field which remain in store, which must not be planted, and the precautions to be taken to prevent spread of the pest with any soil or waste from those potatoes.

¹ The “sampled unit” is the field or part-field from which the soil sample was taken for the PCN test.

5. The Notice will be accompanied by an estimate of the incidence of each species (*Globodera rostochiensis* and *G. pallida*), to help growers plan how to manage the PCN population.

PCN – Background

6. PCN reduce yields by feeding on the developing root systems of potatoes. When the female matures, its body wall forms a tough protective cyst attached to the outside of the root, containing up to 600 eggs. When the potatoes are harvested the cysts generally drop off into the soil, but may still be lodged in eyes or blemishes. The main way in which PCN spreads is by movement of infested soil on equipment, machinery, footwear and tubers. The egg content of the cyst declines with age, most cysts contain fewer than 100 eggs by the time the land has met the minimum six year rotation period required for seed potato production.

7. Eggs within the cyst may survive in the soil for 20 years or more. When host plants (e.g. potatoes) are planted in that soil, chemicals released from their roots stimulate the eggs within the cysts to hatch allowing juvenile PCN to enter the roots of the developing crop. In the absence of host plants, some eggs will hatch spontaneously each year, but those juveniles will be unable to develop, so the population decreases slowly over time.

8. PCN move only small distances on their own. Their distribution is therefore very variable within a field, showing dense “hotspots” where the pests have multiplied, between areas with lower concentrations. Cultivation tends to spread the cysts through the soil, so a field which has been cultivated several times since the last potato crop will have a more even distribution. The methodology for sampling soil aims to provide a representative picture of the PCN population without excessive costs, but without very intensive (and expensive) sampling it is always possible that one of these “hotspots” will be missed.

9. There are two species of PCN present in Scotland, *Globodera rostochiensis* and *G. pallida*. *G. rostochiensis* was previously dominant in all parts of the UK, but *G. pallida* is now dominant in England and increasingly so in Scotland. Over the past 25 years, the incidence of *G. pallida* relative to *G. rostochiensis* in pre-crop soil tests has increased from a ratio of 1:25 to a ratio of 1:1. *G. pallida* is now the more commonly found species of PCN in Angus, although *G. rostochiensis* remains the more frequently encountered species in other counties. Varieties with high levels of resistance to *G. rostochiensis* are widely grown: 44% of the Scottish seed crop and 52% of the Scottish ware crop has high levels of resistance to *G. rostochiensis*. Fewer varieties with resistance to *G. pallida* are grown commercially: 90% of the Scottish seed crop and 77% of the Scottish ware crop has no resistance to *G. pallida* with the remainder dominated by varieties with low resistance.

Planting in infested fields

10. If you wish to grow ware potatoes on a sampled unit officially recorded as infested, you must put in place a “control programme” approved by the Scottish Government, “aiming at least at the suppression of PCN”. This is a requirement of

the PCN Directive and is important to prevent the increase and spread of PCN to clean land. “Suppression” is interpreted as **measures which will result in the reduction of the PCN population or its management at sustainable levels.**

11. The starting population level is an important factor, but you should take account of the point in the rotation at which that population was found. Tests carried out for seed production, prior to planting, are likely to show lower levels of PCN than those carried out for the ware survey, immediately following a potato crop. A control programme should ensure that the minimum population level (pre-planting) will be lower (or maintained at a sustainable level) in each rotation, although it may well rise each time a crop is planted, depending upon the susceptibility/resistance of the variety, as in the following example:

New picture

Source: Potato Council PCN Calculator (<http://www.potato.org.uk/online-toolbox/pcn-calculator>)

12. Very high levels of PCN pose a significant risk of spread, as it is more likely that even a small amount of soil will contain cysts. If your starting population is very high, you may need to take measures to reduce this immediately (e.g. by growing a variety with very high resistance) rather than relying on natural decline.

13. The control programme may use any suitable combination of the control methods outlined below. It is important to take into account the soil type and other environmental and cultivation factors affecting the unit. It may be helpful to consult an agronomist or use a computer model, such as that provided by the Potato Council (<http://www.potato.org.uk/online-toolbox/pcn-calculator>), to assess the effect of different options.

Procedure and enforcement

14. The proposed control programme must be submitted to your local SG-AFRC Area Office for approval. A suggested template is provided at Annex 2. Straightforward programmes can be approved at local level but more complex proposals may be referred to SASA for assessment and may require some discussion. Once the Scottish Government is satisfied that the measures put forward will be successful in suppressing the PCN population, the programme will be set down in a Statutory Notice, and will then be legally binding on the grower. It will be enforced by checking that the required measures have been taken. There will be no official tests to determine whether PCN population levels have in fact declined.

15. The control programme **must be approved before you plant** any potatoes in land recorded as infested. Please make sure you submit your proposals at least 6 weeks before you require approval, to allow time for assessment and discussion. You may wish to have your control programme approved before you purchase seed or agree to rent the land. If you plan to undertake any specific measures to reduce the PCN population prior to planting potatoes, it may be helpful to have the control programme in place before carrying out those measures, to ensure they are approved and fully recorded.

16. If you fail to manage the land in accordance with the control programme, the Notice may be amended, for example to require a longer rotation before another

crop can be planted. You can also request a change to the programme, for example if you wish to plant a crop sooner using a different variety or additional chemical controls. Changes must be agreed before you plant, as crops planted in contravention of the Notice may be destroyed. **Serious or repeated breaches of the plan may lead to prosecution.**

Seed growers

17. **Please note that a control programme is only required if you wish to grow ware potatoes in the land recorded as infested. If you wish to return the land to seed use we recommend that you do not plant potatoes**, to eradicate the PCN as quickly as possible.

18. An application for a soil test to lift the recording restrictions will not be accepted until a minimum of 6 years has elapsed since the last official soil test, or harvesting of the last potato crop grown in that field, whichever is later. Sampling for de-recording will be at the standard rate of 1500ml/ha, which will detect PCN populations at lower population levels than the reduced rate of 400ml/ha. If a moderate or high infestation was originally detected using the reduced sampling rate, it is likely to take considerably more than 6 years for the population to decline far enough to achieve a negative result in a de-recording test.

Control methods

Rotation

19. A long rotation period is the most reliable way of reducing PCN populations. There is a significant reduction in viable eggs in the first six years without host plants, therefore this is recommended as the minimum length of rotation. The rate of decline depends on a number of environmental factors, particularly soil type, and *G. pallida* generally declines more slowly than *G. rostochiensis*.

20. Volunteer potatoes enable PCN to multiply and should be controlled as early as possible each year.

Resistant varieties

21. Potato varieties resistant to PCN prevent most nematodes developing into adults and therefore reduce the increase in population normally caused by planting host plants. Use of varieties with high resistance can achieve suppression with shorter rotations or less use of chemical treatments than would otherwise be required. However, a very small proportion of cysts do reach maturity on even highly resistant varieties. When using resistant varieties, careful note should be taken of the species of PCN to which the variety is resistant. The resistance of a variety to the two species of PCN is rarely similar. Therefore, planting a variety with high resistance to *G. rostochiensis* may enable *G. pallida* to multiply (and vice versa) as they may still be present at levels too low to be detected.

22. The level of resistance of potato varieties, to both *G. rostochiensis* and *G. pallida*, is assessed as part of National List testing. Many varieties score highly in terms of resistance to *G. rostochiensis*, but relatively few have significant resistance to *G. pallida*. SASA can provide assessments of the susceptibility/resistance of varieties as relevant to a control programme. Information on resistance can also be found on the British Potato Variety Database maintained by the Potato Council (<http://www.varieties.potato.org.uk/menu.php>). Varieties from the EU Common Catalogue may also be planted in Scotland, but advice should be sought from SASA since resistance testing has only recently been standardised across Europe.

Tolerant varieties

23. Varieties described as “tolerant” to PCN can produce good yields despite the presence of PCN. However, they have little or no impact on the nematodes’ development and can in fact lead to an increase in the PCN population. For this reason, the planting of tolerant varieties should only be included in a control programme in combination with other measures which are sufficient to achieve suppression.

PCN tested seed

24. It is recommended that seed potatoes to be planted in land officially recorded as infested, for the production of ware, should be either classified seed or, if farm saved seed is used, should come from land which has been tested and found clear of PCN, to avoid the risk of importing new populations into the field. (Please note that, in any circumstances, farm saved seed from untested land can only be planted on the same holding where it was produced.)

Chemical control

25. A number of chemical treatments for PCN are available. However, none of them offer complete control, and their effectiveness depends on various factors including soil conditions and weather, and the method and timing of application. As with tolerant varieties, some nematicides can protect yields but generally are less effective in reducing post-harvest PCN populations.

26. Care should be taken when using “precision farming” techniques and GPS to apply chemical treatments only where PCN have been found, because there may be unidentified hotspots in the sampled unit, or PCN may be present at undetectable levels between hotspots.

Other methods

27. A number of other methods have been used or proposed for the control of PCN. These include:

- Biofumigation, using other plant species to generate gases which kill the cysts in the soil;
- Trap cropping, planting a crop of potatoes to stimulate the eggs to hatch and then removing the plants before the nematodes can complete their life cycle. Other plants may also be proposed that stimulate hatching but do not provide a host for the juveniles;
- Biocontrol, through other organisms which prey on or parasitise the PCN.

These methods may be effective in certain circumstances, but at present there is a shortage of independent evidence on the degree of control they offer in different conditions. Inclusion of these methods in a control programme is likely to require careful consideration and detailed information about how they will be applied, before they can be approved.

Hygiene and waste disposal

28. Potato growers should always follow good practice to prevent the spread of pests and diseases, and this is especially important where PCN is known to be present. Machinery, equipment and footwear should be cleaned after working in the infested area or handling tubers from that unit, and care should be taken to avoid any cross-contamination between those tubers and any seed potatoes, including those which may be retained as farm saved seed.

29. All waste, soil and by-products from potato harvesting, grading and processing operations should be disposed of in line with the Plant Health Code of Practice on Management of Agricultural and Horticultural Waste², and therefore no additional waste disposal requirements apply to material from fields officially recorded as infested. In particular, the following approaches can be used to reduce the amount of waste sent to landfill:

- Excess soil should be left in the field if possible, or where a grower grades his own potatoes on-farm, the soil may be returned to the field of origin;
- Soil and potato waste may be returned to non-agricultural land, or to sacrificial land that is unsuitable for growing potatoes for other reasons;
- Unwashed stockfeed should only be used on farms which do not grow potatoes.
- Washed stockfeed carries a very low risk and can be used on any farm.

These arrangements have been agreed with the Scottish Environment Protection Agency.

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<http://www.fera.defra.gov.uk/plants/publications/informationBooklets.cfm>.

Rented land

30. If PCN is found on land which is rented out for potatoes, the landowner has a responsibility to inform future tenants that the sampled unit is officially recorded as infested, and alert them to the controls in place. Both the landowner and the tenant could be liable to sanctions, including crop destruction or prosecution, if potatoes are planted in the land without an official control programme being in place, or in contravention of an existing control programme. Restrictions may also affect tenants using the field for purposes other than potatoes, so all tenants should be informed.

31. A control programme for rented land can only be agreed with someone who has control over that land and what is done there. There are several ways in which this could be achieved:

- a) If the tenant rents the land on a long-term basis, they could agree a control programme, subject to a condition that the agreement would fall if they cease to have control of the land;
- b) The landowner could agree a long-term programme which tenants of the land would be required to comply with;
- c) Short-term programmes could be agreed by each successive tenant for the duration of their tenancies.

A short-term programme might simply be to grow ware potatoes in the year of the tenancy, giving details of the variety to be grown and any chemical or other controls to be applied at the same time. The Scottish Government will take account of the history of the land since it was recorded as infested in determining whether to agree such a proposal. This would include consideration of when the last potato crop was grown and what measures were taken at that time and in the intervening period. If no active measures have been taken to reduce the PCN population, it is likely that a rotation period of at least 6 years, possibly significantly longer, will be required. It is advisable to check what the requirements will be before agreeing to rent land which is officially recorded as infested.

32. The owner of land which is normally let for potato production, and which has been officially recorded as infested, may wish to take action to reduce the PCN population before letting the land for potatoes again. Such action, between potato crops, would not need to be agreed as part of a control programme. However, landowners should take care to obtain independent advice, to ensure that any treatments used will be effective in Scottish conditions.

OTHER PLANTS SUBJECT TO CONTROLS

In addition to potatoes, some restrictions apply to the production of propagating material of other plants which are either hosts of PCN or are likely to be grown in rotation with potatoes and have the potential to spread the pest. **These controls apply only to plants grown in soil intended for transplanting with roots or soil attached.** As these plants are usually grown in Scotland from true seed and planted in soil-free composts, these restrictions are rarely expected to apply.

The affected species are organised in categories as follows:

A. Host plants

<i>Capsicum</i> spp.	(Sweet peppers and chillies)
<i>Lycopersicon lycopersicum</i> (L.) Karsten ex Farw.	(Tomato)
<i>Solanum melongena</i> (L.)	(Aubergine)

B. Other plants with roots

<i>Allium porrum</i> L.	(Leek)
<i>Beta vulgaris</i> L.	(Beet)
<i>Brassica</i> spp.	
<i>Fragaria</i> L.	(Strawberry)
<i>Asparagus officinalis</i> L.	

C. Bulbs, tubers and rhizomes

<i>Allium ascalonicum</i> L.	(Shallot)
<i>Allium cepa</i> L.	(Onion)
<i>Dahlia</i> spp.	
<i>Gladiolus</i> Tourn. Ex L.	
<i>Hyacinthus</i> spp.	
<i>Iris</i> spp.	
<i>Lilium</i> spp.	
<i>Narcissus</i> L.	
<i>Tulipa</i> L.	

Host plants (category A) intended for planting are subject to similar restrictions as for seed potatoes.

- They may only be grown in soil which has been found clear of PCN through a pre-planting soil test, unless they are to be used on the same place of production.
- In order for any field to qualify for the lower sampling rate, documentary evidence must show that no potatoes or other host plants have been grown in the field for the required period.
- Plants which have been grown in a field officially recorded as infested must not be replanted.

Plants in categories B and C, intended for planting, must be grown in soil which has either passed a pre-planting soil test, or where it can be shown that no PCN has been found in the field, or no potatoes or other host plants have been grown in the field, for 12 years. These plants, bulbs etc are exempt from the restrictions if they are washed or brushed until practically free of soil, so that there is no identifiable risk of them spreading PCN. Plants in category C are also exempt if they are intended for replanting only by professional plant or cut flower producers (not for final retail sale).

TEMPLATE FOR A PROPOSED CONTROL PROGRAMME

NB: A control programme is only required if you intend to grow ware potatoes in land officially recorded as infested with PCN. No seed potatoes may be grown in such land.

The control programme **must be approved before you plant** any potatoes in land recorded as infested. You may wish to have the programme approved before you buy seed or agree to rent land recorded as infested, or before you take any measures to control PCN prior to planting potatoes. Please make sure you submit your proposals at least 6 weeks before you require approval, to allow time for assessment and discussion.

There is no form for submitting a proposed control programme to the Scottish Government, but the following information should be included:

1. Name and address of applicant
2. Identification of the sampled unit to which the control programme will apply – include farm code and LPID number, and further description as necessary.
3. Reference number and date of the Statutory Notice recording the unit as infested (if the Notice was not served on you, this information will be available from the land owner or from your local Area Office).
4. Year in which you intend to plant the first crop of ware potatoes.
5. Variety to be grown.
6. Chemical or other control methods to be used before or during first crop – please give full details of product, timing, method of application etc.

(Details of variety and chemicals are only required if the crop is to be planted within the first 18 months of the programme.)

7. Rotation period for future potato crops.
8. Measures to be taken between potato crops:
 - Other crops to be grown in rotation with potatoes
 - Chemical or other methods to be used between potato crops to control the PCN population
 - Methods to be used to control any volunteer potatoes.

This information should be submitted to your local SG-AFRCD Area Office. Details are available on the Scottish Government website www.scotland.gov.uk under Topics – Farming

<http://www.scotland.gov.uk/Topics/farmingrural/Agriculture/AOcontacts/contacts>