



Department  
for Environment,  
Food & Rural Affairs

## Plant Pest Factsheet

Columbia root-knot nematode

*Meloidogyne chitwoodi*



**Figure 1.** *Meloidogyne chitwoodi* infested potato tuber, courtesy of Fera Science Ltd.

## Background

*Meloidogyne chitwoodi* (Golden *et al.*, 1980) is a root-knot nematode, commonly known as the 'Columbia root-knot nematode'. This species was first found and described from roots and tubers of potatoes in a field near Quincy, Washington State, USA. *Meloidogyne chitwoodi* is a regulated quarantine pest in GB, NI and the EU and is an economically important pest of potato. The symptoms on tubers and roots are similar to those caused by other root-knot nematodes, typically inciting small galls (Figure 1). The surface of infested potato tubers usually exhibits numerous pimple-like raised areas; however, this can be variety dependant.

## Geographical Distribution

*Meloidogyne chitwoodi* is present, but not widely distributed and under official control in GB, following a report from a single field in eastern England. It has also been reported from Europe: Belgium, Bulgaria, Denmark, France, Germany, Lithuania, the Netherlands, Portugal, Romania, Spain, Sweden, Switzerland and Turkey; North America: Mexico and USA (California, Colorado, Idaho, Nevada, New Mexico, Oregon, Texas, Utah and Washington); South America: Argentina and Chile; and Africa: Mozambique and South Africa.

## Host Plants

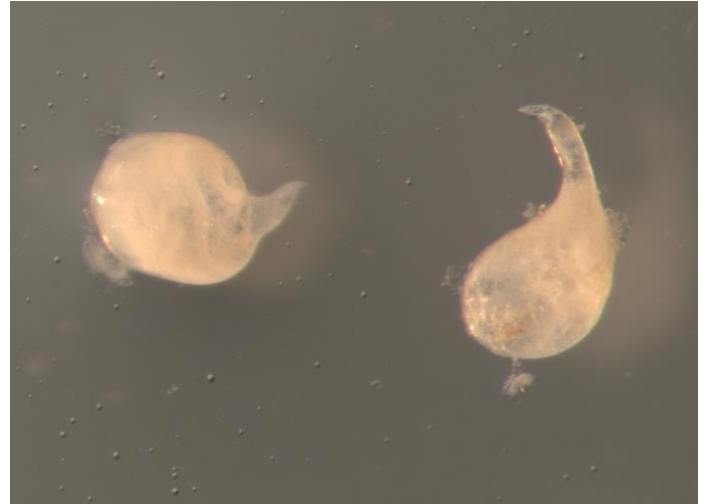
*Meloidogyne chitwoodi* has been reported to infest a wide range of hosts. Major hosts include *Solanum tuberosum* (potato) and *Solanum lycopersicum* (tomato). Minor hosts include *Avena sativa* (oat), *Beta vulgaris* (beet), *Daucus carota* (carrot), *Hordeum vulgare* (barley), *Medicago sativa* (alfalfa), *Phaseolus vulgaris* (bean), *Pisum sativum* (pea), Poaceae (grasses), *Scorzonera hispanica* (black salsify), *Taraxacum officinale* (dandelion), *Triticum aestivum* (wheat) and *Zea mays* (maize).

## Description

*Meloidogyne chitwoodi* is a microscopic invertebrate, making adult nematodes difficult to detect without the use of a magnifying lens. Eggs are very small, approximately 0.09 mm long and 0.05 mm wide and are contained as a mass within a gelatinous matrix, about five to six times the size of the adult female. Infective juveniles and males are soil-borne, worm-like in shape and around 0.03 mm wide and 1 mm in length (Figure 2). Adult females are usually embedded within plant roots or tubers and therefore immobile. Females are pearly white, spherical in shape with a distinctly offset neck region, up to 0.7 mm long and 0.5 mm wide (Figure 3).



**Figure 2.** Two infective *Meloidogyne chitwoodi* second stage juveniles. Image courtesy of FERA Science Ltd.



**Figure 3.** Two adult female *Meloidogyne chitwoodi*. Image courtesy of FERA Science Ltd.

## Biology

The lifecycle of *M. chitwoodi* is similar to that of other root-knot nematode species. All root-knot nematodes have an embryonic stage, four juvenile stages and an adult stage. Within the egg, the first juvenile stage moults to form the second juvenile stage, this second juvenile then hatches from the egg. The hatching is temperature dependent and does not always require a stimulus from plant roots. However, plant root secretions (fluids produced by plant roots) sometimes stimulate hatching. Second stage juvenile nematodes are the infective stage and gather at the plant's region of cell elongation just behind the root tip. This accumulation of nematodes even occurs on plants which are resistant to root-knot nematodes. They are also attracted to other growing root tips, points where lateral roots emerge, and invasion sites of other juveniles. Upon entering the plant root at these invasion sites, juveniles move within the root and stimulate feeding site formation by injecting the host tissue. This causes feeding cells to develop, generally known as giant cells.

As giant cells form, the surrounding root tissue gives rise to a gall in which the developing juvenile is embedded and can no longer move. The root tip may enlarge, and root growth often stops for a short period. After further feeding, the juveniles moult three times and eventually become adults. The life span of an adult female may extend to three months and many hundreds of eggs can be produced. Females can continue egg laying after the harvest of aerial parts of the plant. The egg stage is the most likely to survive between crops and eggs have been noted to survive for up to four years in the soil. Infective juveniles can also persist within soils for more than one year. *Meloidogyne chitwoodi* can survive soil temperatures below 0°C.

## Dispersal and Detection

Typical symptoms of infestation by root-knot nematodes are gall formation on roots and tubers (Figure 4). However, above-ground symptoms are similar to those produced on any plants with a damaged and malfunctioning root system (Figure 5). Symptoms include:

- i. suppressed shoot growth and accompanying decreased shoot–root ratio;
- ii. nutritional deficiencies showing in the foliage, particularly chlorosis (yellowing);
- iii. temporary wilting during periods of mild water stress or during the hottest part of the day, even when adequate soil moisture is available; and
- iv. reduced plant yields.

The severity of these symptoms is often related to the number of juveniles penetrating and becoming established within the root tissue of young plants. The common explanation for these above-ground symptoms is that root-knot nematode infection affects water and nutrient uptake and upward translocation by the root system. In general, the tolerance limit of most crops to root-knot nematodes is less than 1 egg per cm<sup>3</sup> of soil.



**Figure 4.** *Meloidogyne chitwoodi* infested potato tuber exhibiting skin swelling and dimpling. Image courtesy of FERA Science Ltd.



**Figure 5.** *Meloidogyne chitwoodi* infested potato field, courtesy of ILVO.

The infective juveniles of *M. chitwoodi* can move approximately 1 m per annum through soil substrates without human intervention. Spread over longer distances can occur by human interactions with infested soil, e.g. infested soil residues adhering to footwear, planting material and farm machinery. *Meloidogyne chitwoodi* may also be transported within planting material without the presence of soil residues. Nematode movement can also be facilitated by contaminated irrigation water.

## Economic Impact

The internal necrosis and external swelling of potato tubers infested with *M. chitwoodi* can result in the reduction in the market value of the crop. *Meloidogyne chitwoodi* infestation can reduce potato tuber yields and tubers can continue to develop symptoms during storage. This nematode is also capable of causing yield losses in other crops including barley, carrot, oats, maize, and wheat.

## Pest Management and Reporting

Potatoes and other host crops are most at risk from this pest when they are grown on sandy soils, this is often reported for *Meloidogyne* species. Sampling soils for plant-parasitic nematodes prior to planting will provide information on the identity of field populations. Control strategies based on the growing of non-hosts or resistant (trap) crops (or cultivars) in a crop rotation system may be effective. Effective weed control is essential to the success of any crop rotation, as the presence of weed hosts in the field can result in the development of high populations of root-knot nematodes despite the poor host status of the crop. Brassicaceous crops are recommended for management of *M. chitwoodi*, although field mustard (*Brassica rapa*) cv. S94152 has been reported to be a good host. The application of nematicides reduces the impact of *M. chitwoodi*, however if crops are grown in short rotation, the impact of treatments will be short-lived. As a consequence, the application of nematicides may only be an effective measure in combination with appropriate crop rotation. It is also worth noting that nematicides are increasingly being lost from use so can not be relied upon in the long term.

An important component of cultural control is to minimize root-knot nematode movement between planting sites or into new production areas (e.g. sanitation). This may be achieved by:

- i. removal/destruction of infested plant material prior to replanting a site;
- ii. inspection and use of certified nematode free plants from reliable nurseries or farms;
- iii. cleaning of farm implements, machinery, footwear;
- iv. minimising the presence of soil on root crops especially seed crops;
- v. effective management of waste at packing and processing sites and
- vi. heat treatment of potentially infected plant material (e.g. roots, tubers etc).

Suspected outbreaks of *M. chitwoodi* or any other non-native plant pest should be reported to the relevant authority:

For **England and Wales**, contact your local **APHA Plant Health and Seeds Inspector** or the **PHSI Headquarters**, York.

Tel: 0300 1000 313

Email: [planthealth.info@apha.gov.uk](mailto:planthealth.info@apha.gov.uk)

For **Scotland**, contact your local **RPID officer**: Web site:  
<http://www.gov.scot/Topics/farmingrural/Agriculture/AOcontacts/contacts>

Email: [potatoexports@sasa.gov.scot](mailto:potatoexports@sasa.gov.scot)

For **Northern Ireland**, contact the **DAERA Plant Health Inspection Branch**:

Tel: 0300 200 7847 Email: [planthealth@daera-ni.gov.uk](mailto:planthealth@daera-ni.gov.uk)

Web: <https://www.daera-ni.gov.uk/topics/plant-and-tree-health>

For additional information on UK Plant Health please see:

<https://planthealthportal.defra.gov.uk/pests-and-diseases/uk-plant-health-risk-register/>

<https://planthealthportal.defra.gov.uk/>

<https://www.gov.uk/plant-health-controls>

<http://www.gov.scot/Topics/farmingrural/Agriculture/plant/PlantHealth/PlantDiseases>

<https://www.daera-ni.gov.uk>

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