

# Root-knot nematodes (RKN)

## INTRODUCTION

**Plant-parasitic nematodes – especially root-knot nematodes (*Meloidogyne sp.*) and cyst nematodes – are economically important pests in numerous crops.**

Root-knot nematodes (RKN) are parasites with a broad host plant range. In Europe, more than 20 species can be found. The dominant ones depend on climate type:

### ◀ under cooler conditions:

*M. chitwoodi*, *M. fallax*, *M. hapla* and *M. naasi*

### ◀ under warmer conditions:

*M. arenaria*, *M. Javanica* and *M. incognita*



## IN SHORT

Root-knot nematodes (*Meloidogyne sp.*) are widespread plant parasites causing significant damage to potatoes, carrots or salsify.

Their wide host range, low damage threshold, fast multiplication and the lack of control options make management difficult.

Sugar beet breeder SESVanderHave has developed a novel variety which combines root-knot nematode (RKN) and beet-cyst nematode (BCN) tolerance.

By well integrating this innovative sugar beet variety in the rotation, and if needed, combined with other bad host crops, root-knot nematode populations can be drastically lowered. This strongly reduces the economic impact of the pest on RKN sensitive crops such as potato.



Figure 2 : *M. Chitwoodi* (Source: Wesemael, ILVO)

In the EU, *M. chitwoodi* and *M. fallax* are listed in the EPPO A2 list for quarantine organisms and are subjected to regulations.

## LIFE CYCLE

Root-knot nematodes penetrate the root and influence the physiology of the plant by forming feeding sites (also called giant cells). Thereby they induce galls (also called knots) on roots and tubers.

Eggs are released in a gelatinous matrix. RKN may overwinter as eggs or as juveniles in the soil where they can survive for at least one year. A high number of eggs combined with several generations per year ensure under favorable conditions rapid population multiplication.

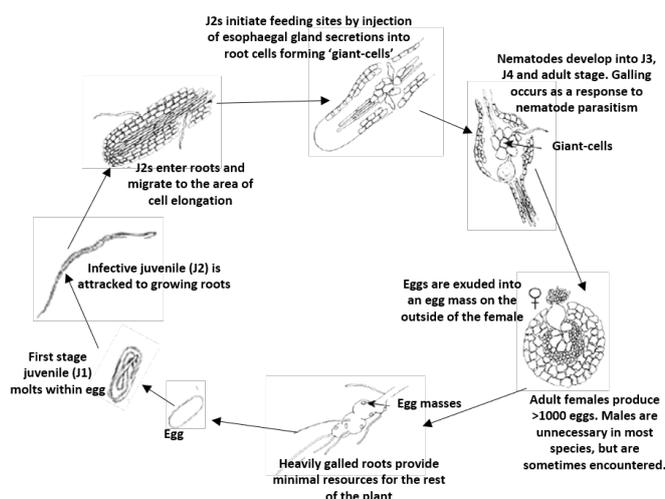


Figure 3 : Life cycle of root-knot nematodes (*Meloidogyne* sp.)  
(Source: Mitowski and Abawi 2011)

## Pest symptoms and economic impact

*M. chitwoodi* and *M. fallax* cause damage in crops such as potato, carrots, black salsify, and certain flower bulbs (gladiolus – dahlia). Reduction in yield is rarely observed. Their presence has however strong financial impact as they make these crops often commercially unacceptable. In sugar beet, they can reduce plant stand. *M. incognita* and *M. javanica*, do impact normal sugar beet root development.

Above ground symptoms on sensitive crops are often absent. Below ground, root-knot nematode is confirmed by the presence of knots (galls) on roots and tubers. The extent of the damage depends on cultivar, population density, temperature, and growing season length.

Presence in potato seed tubers, dahlia and gladioli bulbs leads to refusal of the plant passport or phytosanitary certificate required for movement within or outside the EU.



Figure 4 : RKN damage on potato (Source: Wesemael, ILVO)

		Seed potatoes		Ware potatoes	
		35 T/ha		45 T/ha	
No infection	Certified	30€ct/kg (Class A)	10.500 €/ha	Marketable	10 €ct/kg (consumption) 4.500 €/ha
Infection <5% (low)	Rejected	10 €ct/kg (consumption)	3.500 €/ha	Marketable	10 €ct/kg (consumption) 4.500 €/ha
Infection >5% (medium)	Rejected	3 €ct/kg (flakes)	1.050 €/ha	Rejected	3 €ct/kg (flakes) 1.350 €/ha
Infection >>>5% (high)	Rejected	<3 €ct/kg (feed)	<1.050 €/ha	Rejected	<3 €ct/kg (feed) <1.350 €/ha

Figure 5 : Estimation of the economic impact of presence of root-knot nematodes

# Host plants

The best control measure is to avoid the introduction of *Meloidogyne sp.* If present, however, populations can be kept under control using tolerant or resistant crops. Possibilities are however limited by the extensive range of host plants.

	<i>Meloidogyne hapla</i>	<i>Meloidogyne naasi</i>	<i>Meloidogyne chitwoodi</i>	<i>Meloidogyne fallax</i>
Potato	✓✓✓	—	✓✓✓	✓✓✓
Sugar beet	✓✓✓	✓	✓	✓✓✓
Corn	—	—	✓✓	✓
Onions	✓	✓	✓	✓
Carrots	✓✓	—	✓✓	✓✓✓
Chicory	✓✓	—	—	—
Winter barley / wheat	—	✓✓✓	✓✓	✓
Spring barley	—	✓✓✓	✓	✓
Spring wheat	—	✓✓✓	✓✓	✓✓
Dahlia	✓	—	✓✓✓	✓✓✓
Tulip	—	—	—	?
Gladiolus	—	—	✓✓✓	✓✓✓
Leaf radish	✓✓	—	✓	✓
English / Italian Ryegrass	—	✓✓✓	✓	✓✓✓
Phacelia	✓✓	—	✓	✓
Yellow mustard	✓✓	—	✓✓	✓✓

**Economic damage:**  Unknow  No  Limited  Medium  Strong

**Multiplication factor:** ? Unknow — Active reduction — No ✓ Limited ✓✓ Medium ✓✓✓ Strong ⚡ variety dependent

Figure 6 : Economic damage and multiplication factor for several root-knot nematodes in different crops  
Source: Wageningen University and Productschap Tuinbouw

## ROOT-KNOT NEMATODE RESISTANT SUGAR BEET

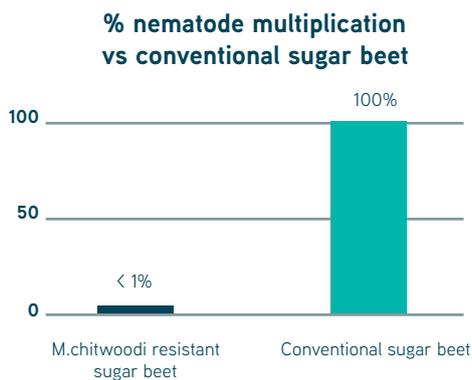


Figure 7 : Multiplication of *M. chitwoodi* in SV resistant sugar beet genetics vs conventional genetics. (WUR)

SESVanderHave has been developing sugar beet genetics with strong *Meloidogyne sp.* resistance. Collaboration with Wageningen University Research confirmed this.

Under glasshouse conditions, resistance to *M. chitwoodi* was tested. The population increase was less than 1% of the maximum increase found for a common sensitive sugar beet variety. Extensive field trial research confirmed these results.

A follow-up study with a very sensitive potato variety (Hansa) showed an outcome that was comparable to black fallow.

Growers will be able to cultivate this sugar beet variety as 'break crop' to reduce the root-knot nematode buildup within the rotation; protecting valuable crops like potatoes, and to reduce the impact from both root-knot and beet cyst nematode on sugar beet itself. This delivers a new and important tool to aid the control of root-knot nematodes.



## INTERVIEW WITH SESVANDERHAVE EXPERT



Olivier Amand

BIOTIC STRESS DEPARTMENT

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## Olivier Amand

#### CAN YOU TELL US ABOUT PLANT PARASITIC NEMATODES AND MORE SPECIFICALLY ABOUT ROOT-KNOT NEMATODES?

OA: Plant parasitic nematodes are microscopic organisms of around 300 to 1000 micrometers. They are widely spread, and several genera are found. Of these genera, *Meloidogyne sp.*, also called root-knot nematodes, can cause significant damage to plant species.

#### WHAT KIND OF DAMAGE IS CAUSED BY ROOT-KNOT NEMATODES?

OA: Most of the damage impacts on quality of the crops, affecting the consumers' acceptance. Infections on potatoes or carrots due to galling can make a crop commercially unacceptable. As *M. chitwoodi* and *M. fallax* are considered quarantine organism, potato seed tubers can lose the phytosanitary passport or plant passport needed to access the market.

#### CAN WE FIND THESE NEMATODES IN ANY ENVIRONMENTAL CONDITIONS?

OA: Root-knot nematodes are mainly present on sandy and sandy loam soils. They have a wide range of host plants and can multiply very rapidly. Introduction of root-knot nematodes

occurs through the importation of infected soil, plant material or in irrigation water. Prevention should be the first line of defense. If, however, nematode populations do establish in a field, further propagation must be prevented, and existing populations need to be eradicated.

#### WHAT ARE POTENTIAL CONTROL OPTIONS?

OA: Few chemical control options (Vydate 10 G, Nemathorin 10 G) do exist but may be discontinued soon. Their effectiveness is limited, and new developments are hardly to be expected. Physical heat treatments or soil steaming are effective, but expensive and can only be used on high value crops or in greenhouses. Other options are a fallow period with weed control, flooding or in warmer climates bio-fumigation.

#### WHAT ABOUT ROTATIONAL CONTROL?

OA: Rotation of crops is a very strong control option as clear differences in susceptibility and on reproduction rate exist.

#### DO RESISTANT VARIETIES EXIST?

OA: *Solanum bulbocastanum*, a wild potato species, can be used as source of resistance against *M. chitwoodi* but breeding takes time. Currently, the main commercial potato varieties are susceptible.

#### WHAT ABOUT SUGAR BEET? HOW AND WHY IS SESVANDERHAVE AS A SUGAR BEET BREEDER CONTRIBUTING?

OA: SESVanderHave always seeks to develop innovative solutions for farmers. We recognize that our growers businesses need to consider the whole rotation and to exploit the rotation to maximize the whole farm income. By introducing sugar beet varieties that combine very strong RKN resistance with beet-cyst nematode, we help growers sustain their whole rotation. With climate change and the need for greater sustainability all breeder, growers and processors need to consider a more holistic approach to maintain output by exploiting our knowledge and genetics wisely. Integrating this innovative variety in the rotation, significantly reduces initial root-knot nematode levels in crops such as potatoes.



### More info?

Check our social media channels and website [www.sesvanderhave.com](http://www.sesvanderhave.com)