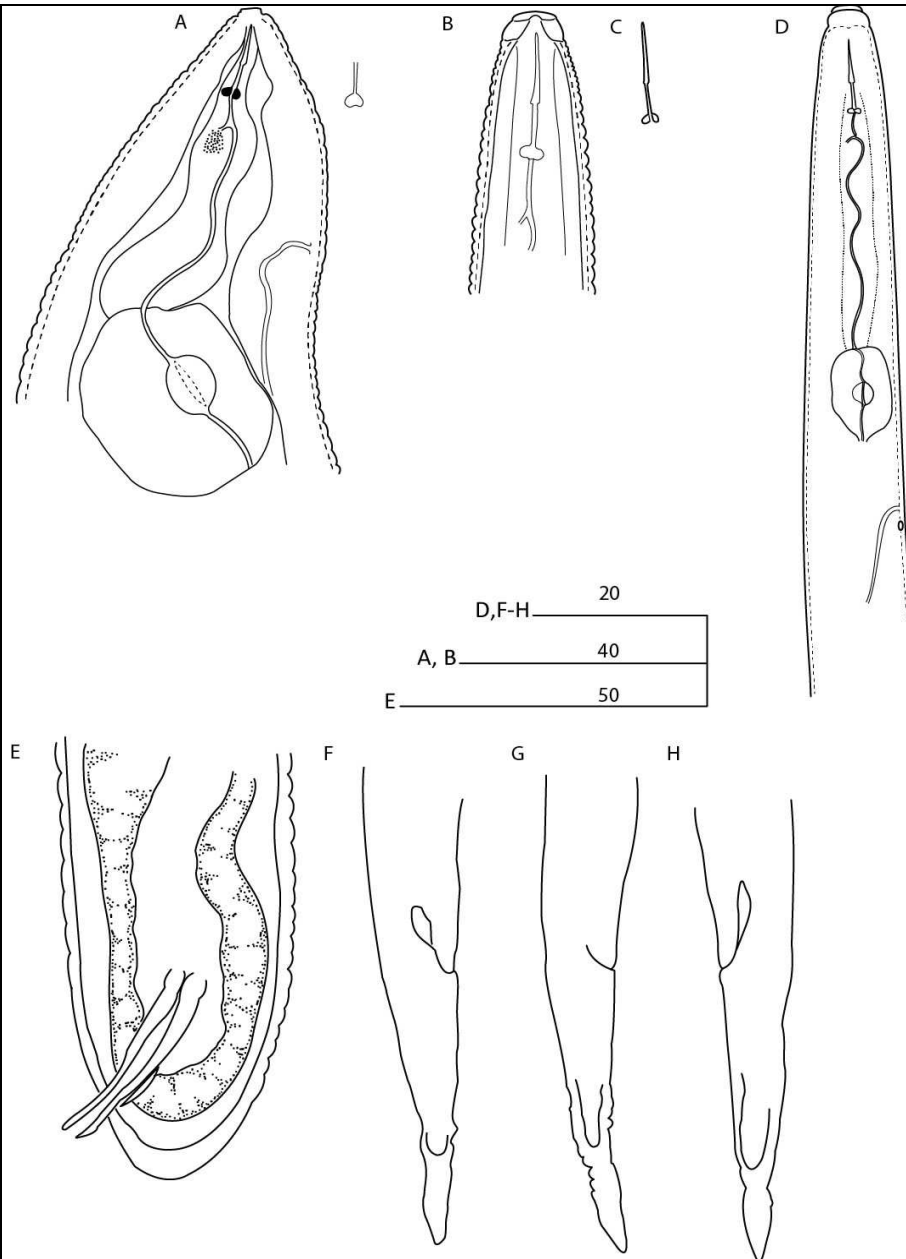




National Plant Protection Organization, the Netherlands

Quick scan number: **QS. nem.2014.01**


Quick scan date: 23 rd May 2014		
1	What is the scientific name (if possible up to species level + author, also include (sub)family and order) and English/common name of the organism? <i>Add picture of organism/damage if available and publication allowed.</i>	<i>Meloidogyne mali</i> Itoh, Ohshima & Ichinohe, 1969 (Nematoda: Meloidogynidae) (4) Syn. <i>Meloidogyne ulmi</i> Palmisano & Ambrogioni, 2000 (8). Recently <i>Meloidogyne ulmi</i> was synonymised with <i>M. mali</i> (1, 2).



Meloidogyne mali A: Female anterior region; B: Male anterior region; C: Male stylet variation; D: J2 anterior region; E: Male posterior region; F-H: J2 tail regions (Ahmed & Karssen, unpublished results, 2013).



Uprooted elm tree in The Hague, heavily infested by *Meloidogyne mali*. (Pictures: mr. Bas Steenks).

		 <p><i>Meloidogyne mali</i> galls on <i>Ulmus</i> sp. roots (Karssen, unpublished).</p>
2	<p>What prompted this quick scan? <i>Organism detected in produce for import, export, in cultivation, nature, mentioned in publications, e.g. EPPO alert list, etc.</i></p>	<p>In 2012/2013 <i>Meloidogyne mali</i> was found on several tree species in the Botanical garden "Belmonte" (Wageningen, the Netherlands) and recently (February 2014) it was detected on the roots of an uprooted elm tree in The Hague. During recent (March, 2014) additional sampling on elms in The Hague, all sampled trees were found to be infested with <i>M. mali</i> at four different localities.</p> <p>Already in 1960, a root-knot nematode was reported from elm trees at Baarn in the Netherlands (7). So far, <i>Meloidogyne mali</i> has been detected in the Netherlands at three former Dutch Elm Disease (DED) experimental fields at Baarn and Wageningen (2, 5, 6), in a botanical garden in Wageningen and more recently in amenity trees in The Hague (see above). <i>M. mali</i> was not detected during a survey on tree nurseries in 2013 in the Netherlands (50 sites visited, uprooted <i>Acer</i>, <i>Quercus</i> en <i>Ulmus</i> were inspected)</p> <p>Most likely <i>Meloidogyne mali</i> has been introduced into the Netherlands prior to WOII with elm material originating from Japan and used for DED elm resistance breeding.</p>
3	<p>What is the (most likely) area of distribution?</p>	<p>Japan and locally in the Netherlands and Italy (it might locally be present in more European countries, see also #4). <i>Meloidogyne mali</i> is a root-parasite described from Japan, where it parasitizes several tree, bush and dicotyledonous herbaceous species (2, 4, 9).</p>

4	Has the organism been detected, sighted and/or has it established itself in surrounding countries (DE, BE, LU, FR, UK) <i>Yes/no. If 'yes', provide details. No interceptions</i>	<i>Meloidogyne mali</i> was introduced in the early nineties from the Netherlands into Italy with young DED resistant elm trees, as part of a European breeding programme (8). Additionally young trees were sent to Belgium, Germany, UK, France, Ireland, Denmark, Spain, Slovakia and Romania (3). It is unclear whether these countries have found <i>M. mali</i> in these trees or whether this material is/was infested.																																		
5	Does the organism cause any kind of plant damage in the current area of distribution and/or does the consignment demonstrate damage suspected to have been caused by this organism? <i>Yes/no + host plants + short explanation of symptoms.</i> <i>Please indicate also when the organism is otherwise harmful (e.g. predator, human/veterinary pathogen vector, etc.).</i>	Already the original species description of <i>Meloidogyne mali</i> reported a very strong root gall induction on apple by this parasite (4). The same type of unusually strong root galling has been observed in elm trees in Baarn, Wageningen and recently in The Hague. A strong galling by root-knot nematodes is in general associated with a reduced plant growth, distorted uptake of water and minerals, increase in pathogen sensibility and lower stability. In extreme root galling plants will die off. A badly developed root system might cause a easier toppling down of trees, the latter might be the reason why the infested tree in The Hague was uprooted in strong winds. It is unknown if this root parasite could make elm trees more susceptible for the Dutch Elm Disease. See 7 for an overview of all known <i>Meloidogyne mali</i> hosts (after 2).																																		
6	Indicate the (provisional) probability of establishment of the organism in the Netherlands regarding climate and ecology. a. In greenhouses (low, medium, high) b. Outdoors (low, medium, high) c. Otherwise (e.g. storage facilities, human environment) <i>Please illustrate with information/references</i>	a. Low (It can establish if host plants are grown in greenhouse soil; (transient) populations may occur in soil less cultures of host plants). b. High, <i>Meloidogyne mali</i> is at least already 50 years present in the Netherlands. Also the known (wide) distribution in Japan suggests strongly that it can survive our present climate conditions easily.																																		
7	What are the host plants? Which host plants are commercially grown in the Netherlands and which are present in the natural environment? <i>If establishment is restricted to greenhouse climate, list only host plants in greenhouses.</i>	<p style="text-align: center;"><i>Host plants of Meloidogyne mali</i></p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center;">Family</th> <th style="text-align: center;">Plant species</th> <th style="text-align: center;">Reference</th> </tr> </thead> <tbody> <tr> <td rowspan="7" style="text-align: center; vertical-align: middle;">Rosaceae</td> <td style="text-align: center;"><i>Malus pumila</i> Mill.</td> <td style="text-align: center;">Itoh et al. 1969</td> </tr> <tr> <td style="text-align: center;"><i>Malus prunifolia</i> Borkh.</td> <td style="text-align: center;">Itoh et al. 1969</td> </tr> <tr> <td style="text-align: center;"><i>Malus Sieboldii</i> Rehd.</td> <td style="text-align: center;">Itoh et al. 1969</td> </tr> <tr> <td style="text-align: center;"><i>Malus pumila</i> "M9"</td> <td style="text-align: center;">Ahmed et al. 2013</td> </tr> <tr> <td style="text-align: center;"><i>Prunus yedoensis</i> Matsum</td> <td style="text-align: center;">Itoh et al. 1969</td> </tr> <tr> <td style="text-align: center;"><i>Rosa hybrida</i> Hort.</td> <td style="text-align: center;">Itoh et al. 1969</td> </tr> <tr> <td style="text-align: center;"><i>Geum coccineum</i> Lindl.</td> <td style="text-align: center;">Ahmed et al. 2013</td> </tr> <tr> <td></td> <td style="text-align: center;"><i>Rubus idaeus</i> L.</td> <td style="text-align: center;">Ahmed et al. 2013</td> </tr> <tr> <td></td> <td style="text-align: center;"><i>Sorbus aucuparia</i> L.</td> <td style="text-align: center;">Ahmed et al. 2013</td> </tr> <tr> <td style="text-align: center;">Vitaceae</td> <td style="text-align: center;"><i>Vitis vinifera</i> L.</td> <td style="text-align: center;">Itoh et al. 1969</td> </tr> <tr> <td rowspan="3" style="text-align: center; vertical-align: middle;">Moraceae</td> <td style="text-align: center;"><i>Morus bombycis</i> Koidz.</td> <td style="text-align: center;">Itoh et al. 1969</td> </tr> <tr> <td style="text-align: center;"><i>Ficus carica</i> L.</td> <td style="text-align: center;">Toida 1979</td> </tr> <tr> <td style="text-align: center;"><i>Maclura tricuspidata</i> (Carriere) Bureau</td> <td style="text-align: center;">Toida 1979</td> </tr> </tbody> </table>	Family	Plant species	Reference	Rosaceae	<i>Malus pumila</i> Mill.	Itoh et al. 1969	<i>Malus prunifolia</i> Borkh.	Itoh et al. 1969	<i>Malus Sieboldii</i> Rehd.	Itoh et al. 1969	<i>Malus pumila</i> "M9"	Ahmed et al. 2013	<i>Prunus yedoensis</i> Matsum	Itoh et al. 1969	<i>Rosa hybrida</i> Hort.	Itoh et al. 1969	<i>Geum coccineum</i> Lindl.	Ahmed et al. 2013		<i>Rubus idaeus</i> L.	Ahmed et al. 2013		<i>Sorbus aucuparia</i> L.	Ahmed et al. 2013	Vitaceae	<i>Vitis vinifera</i> L.	Itoh et al. 1969	Moraceae	<i>Morus bombycis</i> Koidz.	Itoh et al. 1969	<i>Ficus carica</i> L.	Toida 1979	<i>Maclura tricuspidata</i> (Carriere) Bureau	Toida 1979
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			<i>Broussonetia papyrifera</i> (L.) Vent	Toida 1979
			<i>Broussonetia kazinoki</i> Seibold.	Toida 1979
		Fagaceae	<i>Castanea crenata</i> Seib. Et Zucc	Itoh et al. 1969
			<i>Fagus sylvatica</i>	Ahmed et al. 2013
			<i>Quercus robus</i> L.	Ahmed et al. 2013
		Ulmaceae	<i>Ulmus davidiana</i> var. <i>japonica</i>	Toida 1979
			<i>Ulmus chenmoui</i> W.C. Cheng	Palmissano & Ambrogioni 2000
			<i>Ulmus glabra</i> Hud.	Palmissano & Ambrogioni 2000
			<i>Ulmus x hollandica</i> "belgica"	Ahmed et al. 2013
		Sapindaceae	<i>Acer palmatum</i> Thunb.	Itoh et al. 1969
			<i>Acer pseudoplatanus</i> L.	Ahmed et al. 2013
		Fabaceae	<i>Trifolium repens</i> L.	Itoh et al. 1969
			<i>Glycine max</i> (L.) Merr.	Toida 1979
		Taxaceae	<i>Taxus baccata</i> L.	Ahmed et al. 2013
		Balsaminaceae	<i>Impatiens parviflora</i> DC.	Itoh et al. 1969
		Solanaceae	<i>Solanum lycopersicum</i> L.	Toida 1979 & Ahmed et al. 2013
			<i>Solanum melongena</i> L.	Toida 1979
			<i>Capsicum annuum</i> L.	Toida 1979
		Cucurbitaceae	<i>Cucumis sativus</i> L.	Toida 1979
			<i>Cucurbita</i> spp.	Toida 1979
			<i>Citrillus vulgaris</i> Schrud. Ex Eckl. & Zeyh.	Toida 1979
		Cruciferae	<i>Brassica pekinensis</i> Rupy.	Toida 1979
			<i>Brassica oleracea</i> var. <i>capitata</i> L.	Toida 1979
			<i>Brassica napus</i> var. <i>oleifera</i> L.	Toida 1979
		Compositae/Asteraceae	<i>Arctium lappa</i> L.	Toida 1979
		Umbelliferae	<i>Daucus carota</i> var. <i>sativa</i> L.	Toida 1979
		Urticaceae	<i>Urtica dioica</i> L.	Ahmed et al. 2013
8	Provide a provisional estimation of type and probable amount of direct and indirect economic damage (e.g. lower quality, lower production, export restrictions, threat to biodiversity, etc.) likely to occur if the organism would become established?	<p><i>Meloidogyne mali</i> is a quarantine organism for the USA. Any introduction of <i>M. mali</i> within the fruit tree production (like apple) must be avoided. Fruit trees belonging to the family Rosaceae are very good hosts for <i>M. mali</i> (2).</p> <p>Environmental damage as for example indicated by the badly rooted trees observed in The Hague. Infested trees might be uprooted more easily during storms than healthy trees. Financial damage because of the need of replanting. Infested sites are unsuitable for planting of susceptible plant species.</p>		
9	How rapid is the organism expected to spread after introduction (by natural dispersal and human activity)?	The natural dispersal is very low, however <i>M. mali</i> is spread easily by transport of infested trees or soil.		

10	In what manner could the organism enter the Netherlands? <i>Mention pathways.</i>	Import of host plants from Japan. However, the organism is already locally present in the Netherlands and also in Italy. It might also be present in other European countries (see #4).
11	Has the organism been detected on/in a product (cut flowers, fruit, ...) destined for the consumer market? <i>If "no", please go to question 13</i>	no
12	If the organism has been found on/in product other than plants for planting (e.g. cut flowers, fruit, vegetables), are there any risks of introduction and establishment in crop areas and/or natural environment in the Netherlands? <i>Only to be answered in case of an interception and/or a find.</i>	--
13	Additional remarks	The finding of <i>Meloidogyne mali</i> on several localities in The Hague on adult elm trees and the associated weakening of the root system suggests a direct effect of this nematode and an increasing risk of uprooting elm trees during strong winds and storms. Replanting elm trees (or any other host tree) must be avoided. In case of doubts on the stability of the infested elm tree, a tree-pulling test is recommended.
14	References	<p>1. Ahmed, M. (2013). On the species status of the root-knot nematode <i>Meloidogyne ulmi</i> Palmisano & Ambrogioni, 2000 (Nematoda: Meloidogynidae). MSc thesis, Ghent University, Belgium. Pp. 37.</p> <p>2. Ahmed, M., van de Vossenbergh, B.T.L.H., Cornelisse, C. & G. Karssen (2013). On the species status of the root-knot nematode <i>Meloidogyne ulmi</i> Palmisano and Ambrogioni, 2000 (Nematoda, Meloidogynidae). <i>ZooKeys</i> 362: 1-27.</p> <p>3. Heybroek, H.M. (1993). <i>The Dutch elm breeding program</i>. P. 16-25. In: <i>Dutch elm disease research: Cellular and molecular approaches</i>. Eds. M.B. Sticklen & J.L. Sberald. Springer-Verlag, NY.</p> <p>4. Itoh, Y., Ohshima, Y. & M. Ichinohe (1969). A root-knot nematode, <i>Meloidogyne mali</i> n. sp. on apple-tree from Japan (Tylenchida: Heteroderidae). <i>Applied Entomology and Zoology</i> 4: 194-202.</p> <p>5. Karssen, G., van Keulen, I., van Hoenselaar, T. & E. van Heese (2008). <i>Meloidogyne ulmi</i>: een nieuwe iepenparasiet in Nederland? <i>Boomzorg</i> 1 (2): 62-63.</p> <p>6. Karssen, G. (2009). <i>Een nieuwe iepenwortelparasiet</i>. p. 132. In: <i>Iep of Olm, Karakterboom van de Lage Landen</i>. Eds. H.M. Heybroek, L. Goudzwaard & H. Kaljee. KNNV Uitgeverij, Zeist, The Netherlands.</p>

		<p>7. Oostenbrink, M. (1961). Enige bijzondere aaltjesaantastingen in 1960. <i>Tijdschrift over Plantenziekten</i> 67: 57–58.</p> <p>8. Palmisano, A. & L. Ambrogioni (2000). <i>Meloidogyne ulmi</i> sp. n., a root-knot nematode from elm. <i>Nematologia Mediterranea</i> 28: 279–293.</p> <p>9. Toida, Y. (1979). Host plants and morphology of the 2nd-stage larvae of <i>Meloidogyne mali</i> from mulberry. <i>Japanese Journal of Nematology</i> 9: 20-24.</p>
15	Conclusions	<p>This Quickscan concerns the root-knot nematode species <i>Meloidogyne mali</i>. <i>M. mali</i> is a polyphagous Asian nematode species parasitizing on several trees, shrubs and herbaceous species. It is a damaging nematode species able to induce large root galls resulting in a malformed root system with retarded growth and possibly influencing the stability of the trees. It is especially considered a risk for tree species because of the high costs for replacement and because infested trees may be more vulnerable for heavy winds. <i>M. mali</i> has probably been introduced into the Netherlands from Japan with elm root stock. It is known to be locally present in Baarn, Wageningen and The Hague mainly on elm trees.</p>
16	Follow-up measures	<ul style="list-style-type: none"> -Municipalities and the tree nursery industry will be informed about the risk of this species. -An article on <i>M. mali</i> for traders, growers and exporters will be prepared for one of the Dutch tree nursery journals. -As part of plant health checks (plant passport and import), root systems will be examined in case of weakened trees. -<i>M. mali</i> is included in the surveillance programme 2014 (production of apple (<i>Malus</i>) and elm (<i>Ulmus</i>) trees.