

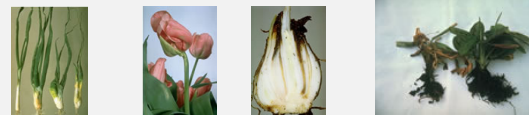
Ogorčice koreninskih šišč *Meloidogyne* spp. v Sloveniji

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Skupščina Društva za varstvo rastlin Slovenije, BF, 9.6.2011

RASTINSKI PARAZITI



- ▶ Paraziti na koreninah, listih, steblu, gomoljih, idr.
- ▶ Imajo bodalo, aparat za hranjenje; prebadanje celic, izločanje produktov sekretornih žlez, sesanje vsebine
- ▶ Endo-, semi-endo-, ecto-paraziti
- ▶ Škoda: neposredna (nekroze, zadebelitve, zmanjšana rast – pridelek); posredna: prenos virusov, interakcije



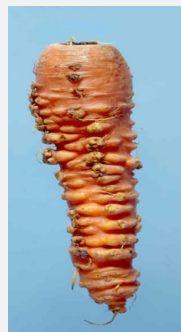
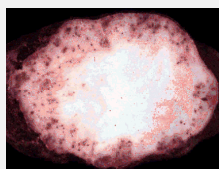
z mikroorganizmi

Meloidogyne sp.

V rod *Meloidogyne* uvrščamo več kot 90 vrst.

- Na 1A2 listi karantenskih organizmov v državah EU:

- *M. chitwoodi*
- *M. fallax*



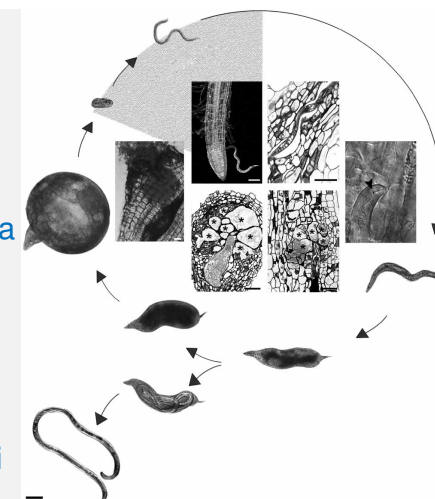
- Najpomembnejše gospodarsko škodljive vrste:

- *M. javanica*
- *M. arenaria*
- *M. incognita*
- *M. hapla*




RAZVOJNI KROG

- Endoparazitske – razvojni krog, razmnoževanje v korenini, J2 – migratorna oblika
- evolucijsko bolj napredne, odvisne od mesta hranjenja, paraziti na molekularni ravni (sekrecija - encimi, rastni regulatorji, regulacijski proteini idr.)
- “Gigantske celice” nenehne celične delitve in rast



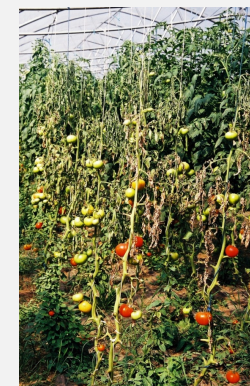
POŠKODBE - ŠKODA




 Kmetijski inštitut Slovenije

POŠKODBE - ŠKODA

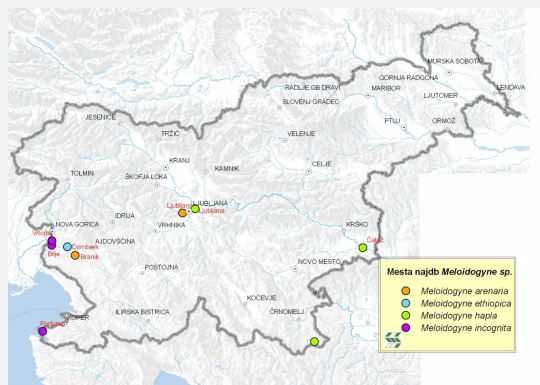
- Uvelost, sušenje, zg. odpadanje cvetov, plodov, zakrnelost -znamenja podobna pomanjkanju vode in hranil




 Kmetijski inštitut Slovenije

V SLO 4 VRSTE

- V Evropi 20 spp.
- V Sloveniji:
 - *M. hapla*
 - *M. arenaria*
 - *M. incognita*
 - *M. ethiopica*




 Kmetijski inštitut Slovenije

M. ethiopica

- *M. ethiopica* opisana 1968
- Afrika, J. Amerika, Evropa
- Neuradno Grčija, Turčija
- je uvrščena v skupino 12 gospodarsko najbolj pomembnih ogorčic iz rodu *Meloidogyne*
- Tipični predstavnik tropske skupine
- Več kot 90 gostiteljev, mono, di, lesnate, zelnate

Continent	Country	Location	Reference
Africa	Ethiopia	along the Awasa Road	O'Bannon, 1975
	Kenya		Karszen, pers.commen.
	Tanzania	Mlalo	Whitehead, 1968
		Lushoto District	Whitehead, 1968
		Tanga	Whitehead, 1968
South Africa			Whitehead, 1969
	Zimbabwe		Whitehead, 1969
South America	Brazil	Rio Grande do Sul: Encruzilhada do Sul Lagoa Vermelha Vila Lângaro	Carneiro <i>et al.</i> , 2003
		Sao Paulo State: Hapetininga	Castro <i>et al.</i> , 2003
	Chile	Apala	Carneiro <i>et al.</i> , 2007
		Casablanca	Carneiro <i>et al.</i> , 2003; Carneiro <i>et al.</i> 2007
		Copapo	Carneiro <i>et al.</i> , 2007
		Cunaquito	Carneiro <i>et al.</i> , 2007
		Curicó	Carneiro <i>et al.</i> , 2003; Carneiro <i>et al.</i> , 2007
		El Mariscal	Carneiro <i>et al.</i> , 2007
		Los Robles	Carneiro <i>et al.</i> , 2007
		Melipilla-Codigua	Carneiro <i>et al.</i> , 2007
		Paine Huacuen	Carneiro <i>et al.</i> , 2007
		Puño Vinilla	Carneiro <i>et al.</i> , 2007
		Pichidegua	Carneiro <i>et al.</i> , 2007
		Rengo	Carneiro <i>et al.</i> , 2007
		Requinoa	Carneiro <i>et al.</i> , 2007
		Sagrada Familia	Carneiro <i>et al.</i> , 2007
		San Clemente	Carneiro <i>et al.</i> , 2007
	Talca	Carneiro <i>et al.</i> , 2007	
	Toihue	Carneiro <i>et al.</i> , 2007	
Europe	Slovenia	Dornberk	Širca <i>et al.</i> , 2004

 Kmetijski inštitut Slovenije

M. ethiopica

Zelenjadnice:

- čebulnice: čebula,
- gomoljnice: sladki komarček,
- kapusnice: brokoli, cvetača, ohrov kolerabica
- korenovke: korenček, redkvice, rd pesa, koleraba, zelena
- plodovke: paradižnik, paprika, kumare, jajčevac, melona, lubenica
- solatnice: endivja, radič, solata
- stročnice: fižol, grah, bob, soja
- špinačnice: špinača, blitva

Russian Journal of Nematology, 2009, 17 (2), 135 - 142 **22 novih gostiteljskih rastlin**

Characterization of the root-knot nematode, *Meloidogyne ethiopica* Whitehead, 1968, from Slovenia

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Accepted for publication 6 June 2009

Summary. A *Meloidogyne ethiopica* population was isolated from heavily infested tomato roots in a glasshouse situated in the village of Dornberk in Slovenia. This was the first finding of *M. ethiopica* in Europe. The species was identified by morphometrical analyses of second-stage juveniles, adult males and females and confirmed by isozyme electrophoresis stained for malate dehydrogenase and esterase. Identification of the species was completed by comparison of small subunit rDNA sequences with those from other *Meloidogyne* species. The sequences of *M. ethiopica* populations from Slovenia and Brazil showed a 99.7% of sequence similarity score and clustered together with high bootstrap support. In addition, bioassays on different host plants were performed to determine host range of the species. Twenty-two new host plants for *M. ethiopica* were established in our tests. This polyphagous nematode can multiply on dicotyledonous as well as on monocotyledonous plants.
Key words: host plants, isozyme phenotypes *Meloidogyne ethiopica*, morphometrics, rDNA.

¹R= Pf/Pi (končna populacija/začetna populacija)

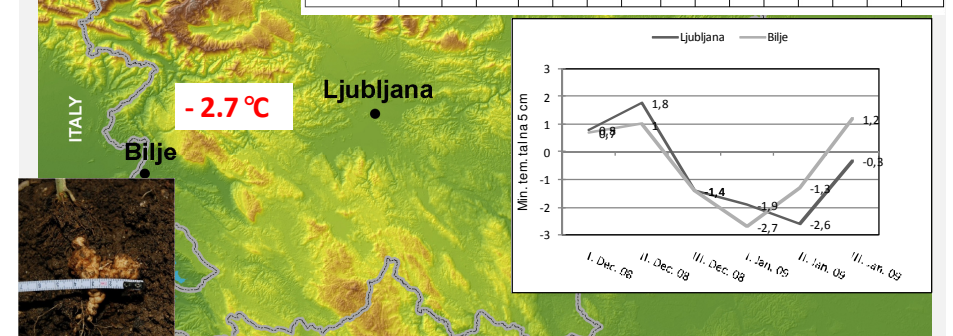
²Kategorije statusa gostiteljskih rastlin:

- ZD= zelo dober (R>10),
- D= dober (10>R>1),
- S= slab (R= +/-1),
- ZS= zelo slab oz. ni gostitelj (1>R>0).



Ljubljana	Novem ber			Decem ber			Januar			Februar			Marec		
leto/dekada	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III
07/08	6,1	3,0	5,0	3,6	1,3	-0,6	-0,1	4,4	1,2	3,2	0,4	5,3	5,3	7,3	5,8
08/09	11,9	7,4	2,0	3,3	4,2	1,1	-1,1	-0,8	0,9	1,2	1,0	2,5	6,2	7,0	6,8
09/10	5,4	7,4	7,4	5,2	0,8	3,4	1,1	0,1	0,0	0,0	0,0	1,1	2,3	3,7	9,1

Bilje	Novem ber			Decem ber			Januar			Februar			Marec		
leto/dekada	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III
07/08	9,4	4,5	7,3	5,6	2,2	0,8	2,7	7,4	4,3	5,9	3,1	6,1	7,0	9,5	8,5
08/09	13,9	8,9	3,6	5,7	6,2	1,7	-0,4	2,2	5,0	6,1	3,4	4,3	8,0	8,6	9,4
09/10	7,3	9,9	10,6	6,4	1,1	5,0	3,3	2,5	0,2	0,9	4,0	6,9	4,3	6,7	11,7



Strajnar et al., 2011. Effect of Slovenian climatic conditions on the development and survival of the root-knot nematode *Meloidogyne ethiopica*. *EJPP* 129, 81-88.

M. ethiopica – EPPO Alert lista

- Širok krog gostiteljev
- Pomembne sadne rastline in trta
- Agresivna vrsta – obsežne poškodbe
- Preživetje
- PRA v teku
- Q organizem ali ne

European and Mediterranean Plant Protection Organization
Organisation Européenne et Méditerranéenne pour la Protection des Plantes

Meloidogyne ethiopica
Root-knot nematode

Why: In 2003, a tropical root-knot nematode species *Meloidogyne ethiopica* was found for the first time in a tomato greenhouse in Slovenia. This was also the first record for Europe. *M. ethiopica* is considered as a damaging species as it can multiply on many different types of plants (dicotyledons and monocotyledons). In addition, it has been shown that this tropical species has the ability to survive outdoors in temperate areas. The Panel on Quarantine Nematodes recommended that *M. ethiopica* should be added to the EPPO Alert List.

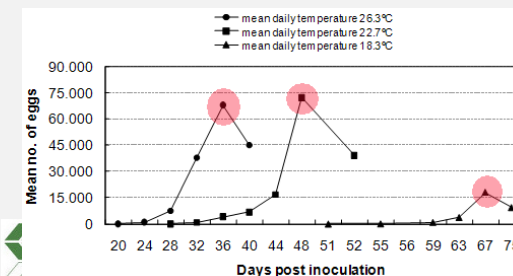
Where: *M. ethiopica* is a tropical root-knot species which was first described in 1968 in Southern Africa (Tanzania). The EPPO region, Slovenia (not established). It was reported once in 2003 near the village of Dornberk on greenhouse tomatoes. The pest is not considered as established in Europe, as the infested tomato crop was destroyed and the pest was not detected again in Slovenia.

Africa: Ethiopia, Kenya, Mozambique, South Africa, Tanzania, Zimbabwe.
South America: Brazil (Rio de Janeiro, Rio Grande do Sul, São Paulo), Chile (detected in the Central Valley from Copiapo (north of Santiago) to Talca).

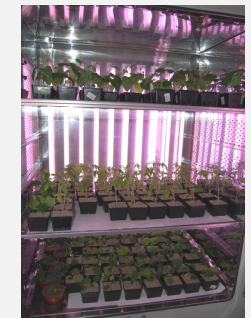
On which plants: *Meloidogyne ethiopica* is a polyphagous pest that is able to parasitize at least 80 different host plants, including many economically important crops. In Africa and South America, *M. ethiopica* has been observed on many different cultivated species such as: *Actinidia deliciosa* (kiwi), *Acta vulgaris* (beetroot), *Brassica oleracea* (cabbages), *Capitulum frutescens* (hot pepper), *Citrus limonum* (watermelon), *Cucurbita* spp., *Eriosea ventricosa* (cassava), *Clypea* (moss), *Lactuca sativa* (lettuce), *Lycopersicon esculentum* (tomato), *Phaseolus vulgaris* (common bean), *Polymnia sachifolia* (yacon), *Solanum tuberosum* (potato), *Vicia faba* (faba bean), *Vigna unguiculata* (cowpea), *Vitis* (vine), *Zingiberaceae*, as well as on tree species (mango) and *Wedelia grandiflora* (cassava). *Solanum nigrum*. Host range experiments have also shown that *M. ethiopica* can multiply on a large number of cultivated plants of economic importance, for example: *Azadirachta indica* (neem), *Cucumis melo* (cucumber), *Daucus carota* (carrot), *Eryngium esculentum* (chicory), *Meloidogyne ethiopica* (cassava), *Persea indica* (cashew), *Meloidogyne ethiopica* (cassava), *Oryza sativa* (rice), *Pisum sativum* (pea), *Prunus persica* (peach), *Solanum melongena* (aubergine), *Spinacia oleracea* (spinach), *Zea mays* (maize).

DOLŽINA RAZMNOŽEVALNEGA KROGA

- ▶ 4 povprečne dnevne temp.: 13.9, 18.3, 22.7 & 26.3°C
- ▶ Paradižnik, kumara, fižol, radič
- ▶ 13.9°C, 120 DPI ni razmnoževanja
- ▶ Max: 67, 48, 36 DPI

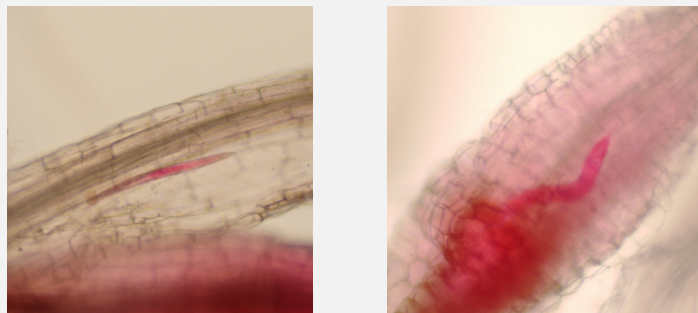


26.3	
Mean no. of eggs	
Tomato	320
Cucumber	4983
	73
	0
	1438
	4983
	10102
	57884
	17850
	117475
	18150
	69100
	20888



BAZALNA TEMPERATURA VSTOPA

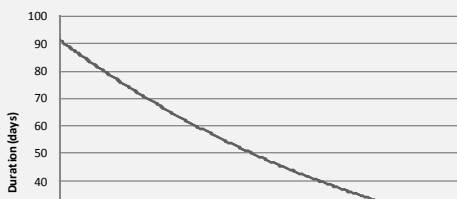
- Testi na paradiznikih
- pri 14°C *M. ethiopica* lahko vstopa in nadaljuje z razvojem



MODEL

- Reprodukcijska krivulja, temp. nad 14°C

$$\ln(y) = 5.2115 - 0.01892 * x * \ln(x)$$



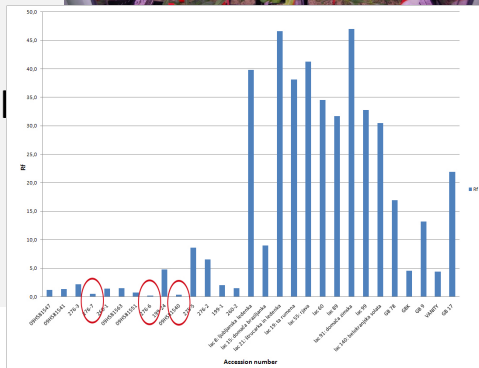
	A	B	C	H	I	J	K
1 datum	dan	temp	D day	D day-1	D day-2		ukrep
20	4. junij 2010	18	19,1	TRUE	TRUE	TRUE	čakaj
21	5. junij 2010	19	20,1	TRUE	TRUE	TRUE	čakaj
22	6. junij 2010	20	21,3	TRUE	TRUE	TRUE	čakaj
23	7. junij 2010	21	22,5	TRUE	TRUE	TRUE	čakaj
24	8. junij 2010	22	23,7	TRUE	TRUE	TRUE	čakaj
25	9. junij 2010	23	23,4	TRUE	TRUE	TRUE	čakaj
26	10. junij 2010	24	24,9	TRUE	TRUE	TRUE	čakaj
27	11. junij 2010	25	25,3	TRUE	TRUE	TRUE	čakaj
28	12. junij 2010	26	26,1	TRUE	TRUE	TRUE	čakaj
29	13. junij 2010	27	26,5	TRUE	TRUE	TRUE	čakaj
30	14. junij 2010	28	27,7	TRUE	TRUE	TRUE	čakaj
31	15. junij 2010	29	25,8	TRUE	TRUE	TRUE	čakaj
32	16. junij 2010	30	24,3	TRUE	TRUE	TRUE	čakaj
33	17. junij 2010	31	22,9	TRUE	TRUE	TRUE	čakaj
34	18. junij 2010	32	23,5	TRUE	TRUE	TRUE	čakaj
35	19. junij 2010	33	21,7	TRUE	TRUE	TRUE	čakaj
36	20. junij 2010	34	20,3	TRUE	TRUE	TRUE	čakaj
37	21. junij 2010	35	18,7	TRUE	TRUE	TRUE	čakaj
38	22. junij 2010	36	17,6	TRUE	TRUE	TRUE	čakaj
39	23. junij 2010	37	19,3	TRUE	TRUE	TRUE	čakaj
40	24. junij 2010	38	21,4	TRUE	TRUE	TRUE	čakaj
41	25. junij 2010	39	22,7	TRUE	TRUE	TRUE	čakaj
42	26. junij 2010	40	24	TRUE	TRUE	TRUE	čakaj
43	27. junij 2010	41	23,7	TRUE	TRUE	TRUE	čakaj
44	28. junij 2010	42	25,1	TRUE	TRUE	TRUE	čakaj
45	29. junij 2010	43	26,6	TRUE	TRUE	TRUE	čakaj
46	30. junij 2010	44	25,9	TRUE	TRUE	TRUE	čakaj
47	1. julij 2010	45	26,6	TRUE	TRUE	TRUE	čakaj
48	2. julij 2010	46	27,5	TRUE	TRUE	TRUE	čakaj
49	3. julij 2010	47	27,2	TRUE	TRUE	TRUE	čakaj
50	4. julij 2010	48	28,7	TRUE	TRUE	TRUE	čakaj
51	5. julij 2010	49	26,3	TRUE	TRUE	FALSE	KOPLJITI!
52	6. julij 2010	50	26,2	FALSE	FALSE	FALSE	KOPLJITI!

- gostiteljski status / testi odpornosti
- napovedovanje št. generacij/rastno sezono (rastlinjaki in na odprtem)

ODPORNOST AKCESIJ SOLATE

M. hapla – BANKA KIS

- Lončni poskusi, 1 razvojni krog, stopnja razmnoževanja
- Začetni inokulum 3000 jajčec/rastlino;
- $R_f = P_i / P_f$, indeks kor. šiši



R = resistant ($G_i < 2$, $R_f < 1$)
 HR = Hipersensitive reaction ($G_i > 2$, $R_f < 1$)
 S = Susceptible ($G_i > 2$, $R_f > 1$)

ARRS, MKGP – Aplikativni projekt L4-1021

HVALA ZA POZORNOST!

Nematologi na KIS:

(levo) Polona Strajnar, Tadej Galič, Saša Širca, Barbara Gerič Stare, Gregor Urek

