Suppressive effect of *Solanum palinacanthum* on root-knot nematodes (*Meloidogyne* spp.)

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Introduction

Background

Root-knot nematodes (RKN, *Meloidogyne* spp.) are plant-parasitic pests that economically impact crop production, particularly in temperate, tropical and subtropical regions of the world. Resistant *Solanum* cultivars have been developed for management of RKNs, such as *Mi*-carrying tomato cultivars and *Solanum torvum*, both of which are also used in Japan. However, they are sometimes ineffective against some virulent *Meloidogyne* spp. Therefore, new *Solanum* species carrying broad-spectrum resistance to *Meloidogyne* spp. is required for the effective management of this pest.

Objectives

- Find new resistant resources from *Solanum* spp. collection
- Find a promising one which bears resistance to multiple *Meloidogyne* spp.
- Demonstrate the suppressive effect of the promising plant on RKN under field conditions

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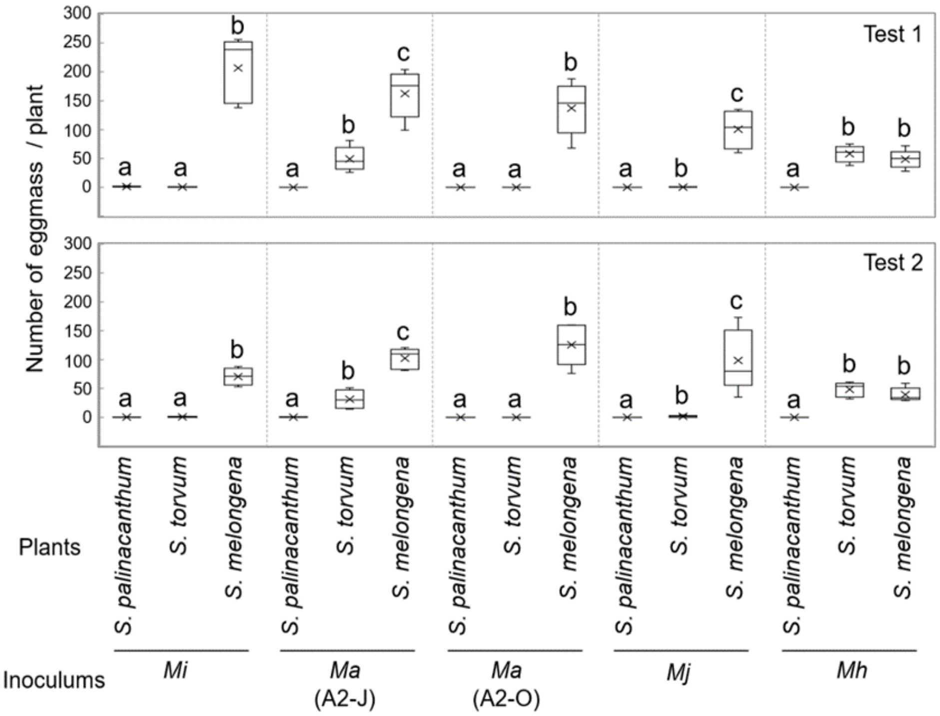
A wild Solanum plant, *Solanum palinacanthum*

Morphology of *Solanum palinacanthum*.
A: young plants. B: mature plants. C: flowers. D: fruits. A,B: Needle-like prickles densely cover the whole plant, and leaves get notches as they mature. C: The corolla of the flower is light purple, with yellow anthers. D: The fruits reach approx. 3.5 – 5.5 cm in dia., with stripes.

- Screened from *Solanum* spp. genetic resources in NARO
- Poor host suitability to *Meloidogyne incognita*

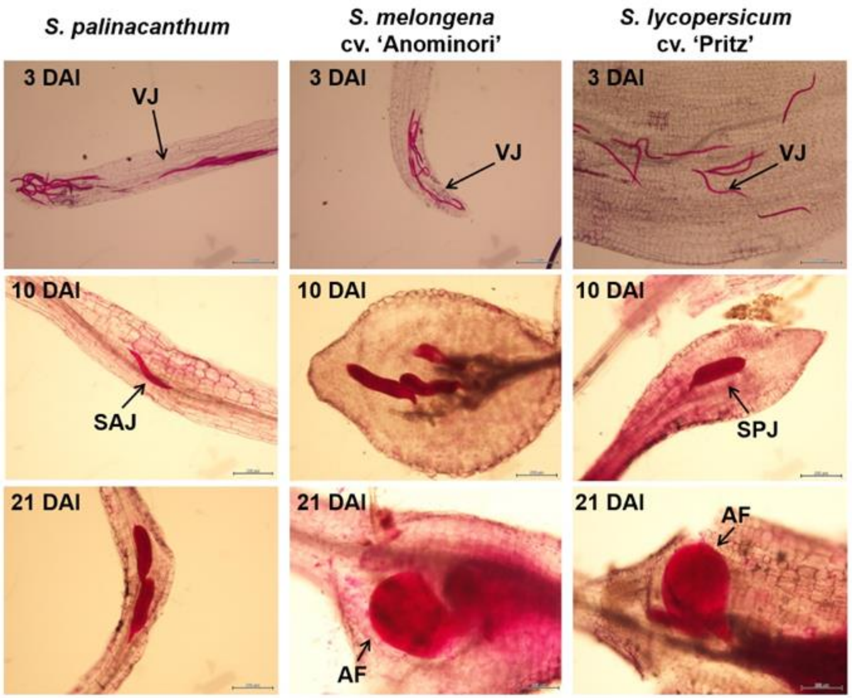
Host suitability for *Meloidogyne* spp. on *S. palinacanthum*



Number of eggmasses of *Meloidogyne* spp. on *Solanum palinacanthum* and *S. melongena* (cv. 'Senryo Nigo') in pot culture.
Plants in 6 cm dia. plastic pots were inoculated with 300 second-stage juveniles per plant (*n* = 5 except for Test 1, *S. melongena* with *M. javanica*, *n* = 4), and egg masses were counted at approx. 40 days after inoculation. The same letters within each panel of 3 are not significantly different according to paired comparisons by GLM with Bonferroni correction (P < 0.05). *Mi*: *M. incognita*, *Ma* A2-J: *M. arenaria* A2-J, *Ma* A2-O: *M. arenaria* A2-O, *Mj*: *M. javanica*, *Mh*: *M. hapla*.

S. palinacanthum is a poor host for all the five *Meloidogyne* inoculums

Evaluation of nematode invasion and development in *S. palinacanthum* roots



Development of *Meloidogyne incognita* within roots of each *Solanum* sp. at 3, 10, and 21 days after inoculation (DAI).
Nematodes were stained with acid fuchsin. *S. melongena* cv. 'Anominori' and *S. lycopersicum* 'Pritz' were susceptible controls.
Stages:
VI = vermiform juvenile
SAJ = sausage-shaped juvenile,
SPJ = spindle-like-shaped juvenile
AF = adult female
*Scale bars = 200 μm.

Evaluation of nematode invasion and development in *S. palinacanthum* roots

Number of each stage nematode of *M. incognita* observed within root system of *S. palinacanthum*, *S. melomgena* cv. 'Anominori' and *S. lycopersicum* cv. 'Pritz'.

Dai	Plant	Total		Vermiform J2[w]	Sausage J2	J3 / initial J4	J4(♀) / adult(♀)	
3	*S. palinacanthum* (*n* = 10)	24.1 ± 4.7 [x]	a [y]	24.1 ± 4.7 (100)	0.0 ± 0.0 (0.0)	0.0 ± 0.0 (0.0)	0.0 ± 0.0 (0.0)	ab [z]
	S. melongena cv. 'Anominori' (*n* = 10)	20.7 ± 4.0	a	20.5 ± 4.1 (98.2)	0.2 ± 0.1 (1.8)	0.0 ± 0.0 (0.0)	0.0 ± 0.0 (0.0)	a
	S. lycopersicum cv. 'Pritz' (*n* = 10)	16.6 ± 3.4	a	16.5 ± 3.4 (99.7)	0.1 ± 0.1 (0.3)	0.0 ± 0.0 (0.0)	0.0 ± 0.0 (0.0)	b
10	*S. palinacanthum* (*n* = 10)	15.3 ± 3.9	a	8.7 ± 1.9 (63.5)	4.6 ± 1.7 (29.2)	2.0 ± 1.0 (7.3)	0.0 ± 0.0 (0.0)	a
	S. melongena cv. 'Anominori' (*n* = 10)	55.5 ± 9.7	b	8.8 ± 3.2 (15.3)	16.3 ± 3.5 (27.6)	30.4 ± 5.6 (57.2)	0.0 ± 0.0 (0.0)	b
	S. lycopersicum cv. 'Pritz' (*n* = 10)	53.1 ± 8.0	b	6.1 ± 1.5 (12.5)	16.1 ± 2.7 (29.8)	30.8 ± 5.5 (57.7)	0.1 ± 0.1 (0.1)	b
21	*S. palinacanthum* (*n* = 10)	13.2 ± 3.8	a	2.9 ± 0.8 (31.6)	5.6 ± 1.5 (42.3)	3.9 ± 1.6 (22.1)	0.8 ± 0.6 (4.0)	a
	S. melongena cv. 'Anominori' (*n* = 10)	76.2 ± 3.4	c	1.1 ± 0.5 (1.4)	8.4 ± 1.0 (11.0)	23.6 ± 2.6 (30.8)	43.1 ± 3.3 (56.8)	b
	S. lycopersicum cv. 'Pritz' (*n* = 10)	40.9 ± 4.0	b	0.2 ± 0.1 (0.4)	3.3 ± 0.7 (7.6)	15.5 ± 1.1 (40.7)	21.9 ± 3.0 (51.3)	b

w VJ = vermiform juvenile, SAJ = sausage-shaped juvenile, SPJ = spindle-like shape juvenile, AF = round-shaped adult female.
x Test 1 (n = 5) and Test 2 (n = 5) data were shown and statistically analyzed together. Mean ± SEM, and the value in parentheses is the ratio to 'Total' for each stage nematode (%).
y Different letters indicate significant differences between plants according to paired comparisons by GLM with Bonferroni correction (*P* < 0.05).
z Different letters indicate significant differences between plants according to paired comparisons by ordinal logistic regression of the transition probability using the percentage data of each stage with Bonferroni correction (paired comparisons for all combinations, *P* < 0.05).

- *M* .incognita was able to invade root of *S. palinacanthum*
- The growth of nematode inside the root remained in earlier stage

Effect of *S. palinacanthum* culture on natural populations of RKN in field trials

Changes in RKN populatioin density (J2s/20 g soil) during cultivation of each planta

Test	Plant	*Pi*		*Pf*		*Pf* / *Pi*	
Test 1	*S. palinacanthum* (n = 5)	305.4 ± 82.4 [b]	n.s. [c]	78.8 ± 33.4	*	0.32 ± 0.16	*
	S. melongena cv. 'Senryo Nigo' (n = 5)	354.0 ± 89.7		2866.7 ± 482.3		13.52 ± 6.54	
Test 2	*S. palinacanthum* (n = 3)	159.8 ± 53.9	n.s.	8.9 ± 4.8	*	0.04 ± 0.02	*
	S. melongena cv. 'Senryo Nigo' (n = 3)	251.7 ± 146.2		2299.6 ± 490.7		28.97 ± 22.47	

a Plants were cultivated in Koshi City from 11 May to 22 August in 2016 (Test 1) and in Tsukuba City from 3 May to 23 September in 2016 (Test 2).

b Mean ± SE

c Letters indicate no significant difference (n.s.) and significant difference (*, $P < 0.01$) according to Student t-test between plants for each test after log10 (X+0.5) transformation (for *Pi* and *Pf*) or Box-Cox transformation (for *Pf* / *Pi*).

Cultivation of *S. palinacanthum* reduced RKN population density in soil

Coclusion

S. palinacanthum showed poor host suitability to all *Meloidogyne* spp. tested in this study, indicating *Solanum palinacanthum* bears broad-spectrum resistance to *Meloidogyne* spp.

The inhibitory mechanism of *S. palinacanthum* to RKN is probably initiated after invasion of RKN and suppresses development and reproduction of the nematode inside the root.

The resistance of *S. palinacanthum* works under field condition. This plant could be a promising genetic resource for developing new resistant cultivars.

Acknowledgements

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Thank you for viewing!