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RESPONSE OF LINES AND CULTIVARS OF TOBACCO AND *NICOTIANA* SPECIES TO ITALIAN POPULATIONS OF *MELOIDOGYNE* SPECIES

by

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Summary. The reaction of lines and cultivars of *Nicotiana tabacum, N. glauca, N. kawakamii, N. longiflora, N. megalosiphon, N. otophora* and *N. repanda* to Italian populations of host race 1 and host race 2 of *Meloidogyne incognita, M. javanica*, host race 2 of *M. arenaria* and *M. hapla* were evaluated in a glasshouse at 26±2 °C. Groups of eight plants of each line or cultivar were planted in plastic trays containing 12 dm^3 of steam sterilized sandy soil, and artificially infested with 10,000 eggs and juveniles of each nematode population per plant. The cultivars Bel 4-30 and RG 17 of *N. tabacum* were resistant to all nematode populations tested. The cv NC 729 was resistant to race 1 and race 2 of *M. incognita, M. javanica* and race 2 of *M. arenaria* and moderately resistant to *M. hapla*. The line of *N. repanda* was resistant only to race 2 of *M. incognita*. The remaining lines and cultivars were susceptible to all populations tested.

Tobacco (*Nicotiana tabacum* L.) is severely damaged by root-knot nematodes (*Meloidogyne* spp.) (Lamberti, 1979a; Di Vito *et al.*, 1983) wherever it is cultivated. These nematodes can be controlled by fumigant and systemic nematicides (Lamberti, 1979b). However, such chemicals are expensive and may pollute the environment. Good control can also be achieved using resistant cultivars. However, while there are several tobacco cultivars resistant to some species of root-knot nematodes only a few are resistant to race 2 of *M. incognita* (Kofoid *et* White) Chitw. This race is the most commonly occurring in Italy (Di Vito and Cianciotta, 1991) but at world level the most important is the host race 1 (Hartman and Sasser, 1985). Therefore, an experiment was undertaken to evaluate the reaction of some lines and cultivars of *Nicotiana* spp. to Italian populations of *Meloidogyne* spp.

Materials and methods

Lines of *Nicotiana glauca* Graham, *N. kawakamii* Ohashi, *N. longiflora* Cav., *N. megalosiphon* Heurck *et* Muell. Arg., *N. otophora* Griseb., *N. repanda* Willd ex Lehm., and lines and cultivars of *N. tabacum* (Tab. I) were sown in 12 dm^3 plastic trays filled with a steam sterilized mixture of peat and sandy soil (v:v 1:1). When at the four-leaf stage, groups of eight seedlings of each line or cultivar were transplanted into further plastic trays filled with steam sterilized sandy soil. Seven days later these seedlings were inoculated with 10,000 eggs and juveniles per plant of one of the nematode populations. Tomato (*Lycopersicon esculentum* Mill.) cv. Rutgers was used as a susceptible control.

The nematode populations used as inoculum were *M. incognita* host race 1 (Taylor and Sas-

TABLE I - *Selection and origin of tobacco tested.*

Species of *Nicotiana*, and accession, line or cultivar	Origin
Nicotiana tabacum	
Cv. "Erzegovina E5-94P5"	Italy (1)
Line "Perustitza 89"	Italy (1)
Line "Xanthi LE 88"	Italy (1)
Line "Faucet Special"	USA (2)
Cv. "Bel 4-30"	USA (2)
Cv. "Mammoth Gold"	USA (2)
Cv. "NC 95"	USA (2)
Cv. "NC 729"	USA (2)
Cv. "RG 17"	USA (2)
Accession "Ti 706"	USA (2)
N. glauca	France (3)
N. kawakamii	France (3)
N. longiflora	France (3)
N. megalosiphon	France (3)
N. otophora	France (3)
N. repanda	France (3)

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ser, 1978; Di Vito and Cianciotta, 1991) from Castellaneta (Apulia), *M. incognita* host race 2 from Lecce (Apulia), *M. javanica* (Treub) Chitw. from Trepuzzi (Apulia), *M. arenaria* (Neal) Chitw. host race 2 from Bovolone (Veneto) and *M. hapla* Chitw. from Ferrara (Emilia-Romagna). All of them had been reared on tomato cv. Rutgers in a glasshouse at 26±2 °C and the inoculum was extracted from infested tomato roots by using the sodium hypochlorite method (Hussey and Barker, 1973). The trays were randomly arranged on benches in a glasshouse maintained at 26±2 °C.

Forty five days after inoculation the plants were uprooted, the roots were gently washed and the gall index (GI) was then assessed according to a (0-5) scale, where 0=no gall on the roots, 1=1-2 galls, 2=3-10, 3=11-30, 4=31-100, and 5 more than 100 galls per root (Taylor and Sasser, 1978). A tobacco plant was considered resistant when the gall index (GI) was≤2.

The data were statistically analyzed and LSD's calculated.

Results and discussion

All lines and cultivars grew well in the glasshouse and all nematode populations used reproduced actively on the susceptible control tomato cv. Rutgers.

The cv. RG 17 of *N. tabacum* was completely free of race 2 of *M. incognita* and *M. javanica* (GI=0) but few galls were found on the roots inoculated with *M. incognita* race 1, *M. javanica* and *M. hapla* (Tab. II). No galls were found on the roots of the cv. Bel 4-30 *N. tabacum* inoculated with *M. arenaria*, while some galls were observed on the roots of the plants inoculated with the remaining nematode populations. Few galls were found on the roots of NC 729 with GI of 1.7, 1.4, 0.7 and 0.4 inoculated with race 1 and race 2 of *M. incognita*, *M. javanica* and *M. arenaria*, respectively (Tab. II).

The GI of the plants of the same cultivar inoculated with *M. hapla* was 2.9. There were few galls on the roots of *N. repanda* inoculated with *M. incognita* race 2. The roots of the remaining eight lines and four cultivars of tobacco were heavily infested by the root-knot nematodes with a GI ranging from 3.5 to 5 (Tab. II).

The roots of the control, Rutgers tomato, were heavily infested by nematodes with a GI of 5.

The cultivars Bel 4-30 and RG 17 were resistant to all nematode populations used in the experiment, while the cv. NC 729 was resistant to race 1 and race 2 of *M. incognita*, *M. javanica* and *M. arenaria* but only moderately resistant to *M. hapla* (Tab. III). *Nicotiana repanda* was resistant to race 2 of *M. incognita* and suscepti-

TABLE II - *Response of lines and cultivars of* Nicotiana *spp. to root-knot nematodes.*

Line and cultivar	Gall index*				
	M. incognita host race 1	*M. incognita* host race 2	*M. javanica*	*M. arenaria* host race 2	*M. hapla*
Erzegovina E5-94P5	3.7	4.7	3.4	5	5
Perustitza LE 89	3.5	4.7	3.2	3.9	5
Xanthi Le 88	3.4	5	3.5	4	5
Faucet Special	5	5	4.9	5	5
Bel 4-30	1.7	1.3	1.9	0	0.7
Mammoth Gold	5	5	4.7	5	3.9
NC 95	5	5	5	5	4
NC 729	1.7	1.4	0.7	0.4	2.9
RG 17	1	0	1.7	0	1
Ti 706	2.6	5	5	3.8	5
N. glauca	3.5	4.6	3.3	3.8	4.6
N. kawakamii	5	5	5	5	3.8
N. longiflora	3.6	3.5	3.4	4	3.6
N. megalosiphon	5	5	5	5	5
N. otophora	–	5	–	–	–
N. repanda	5	0.7	3.3	5	4.1
Tomato (check)	5	5	5	5	5
L.S.D. P=0.05	0.70	0.34	0.53	0.33	0.64
P=0.01	0.92	0.46	0.70	0.43	0.85

* See text.

ble to the remaining nematodes. The accession Ti 706 was moderately resistant to the race 1 of *M. incognita.*

These results indicate that sources of resistance to root-knot nematodes (*Meloidogyne* spp.) are present in different species of *Nicotiana.* Some of the tobacco genotypes, such as the cultivars Bel 4-30 and RG 17 of *N. tabacum*, were resistant to race 1 and race 2 of *M. incognita*, *M. javanica*, race 2 of *M. arenaria* and *M. hapla.*

This finding is very important because the areas were tobacco is cultivated generally are infested by host race 2 of *M. incognita* or with other root-knot nematode species.

Moreover, these sources of resistance to *Meloidogyne* species could be used in plant breeding programmes to obtain cultivars with resistance to the important species of root-knot nematodes such as those used in this experiment, providing that the inheritance of the different resistance sources is also investigated.

TABLE III - *Reaction type of lines and cultivars of* Nicotiana *spp. to root-knot nematodes.*

Line and cultivar	Reaction type*				
	M. incognita host race 1	*M. incognita* host race 2	*M. javanica*	*M. arenaria* host race 2	*M. hapla*
Erzegovina E5-94P5	S	S	S	S	S
Perustitza LE 89	S	S	S	S	S
Xanthi LE 88	S	S	S	S	S
Faucet Special	S	S	S	S	S
Bel 4-30	R	R	R	R	R
Mammoth Gold	S	S	S	S	S
NC 95	S	S	S	S	S
NC 729	S	S	S	S	R(s)**
RG 17	R	R	R	R	R
Ti 706	R(s)	S	S	S	S
N. glauca	S	S	S	S	S
N. kawakamii	S	S	S	S	S
N. longiflora	S	S	S	S	S
N. megalosiphon	S	S	S	S	S
N. otophora	–	S	–	–	–
N. repanda	S	R	S	S	S
Tomato (check)	S	S	S	S	S

* See text; ** R(s) = segregated for resistance.

Literature cited

DI VITO M. and CIANCIOTTA V., 1991. Identificazione delle razze in popolazioni italiane di nematodi galligeni (*Meloidogyne* spp.). *Informatore Fitopatologico, 41* (11): 54-56.

DI VITO M., GRECO N. and CARELLA A., 1983. The effect of population densities of *Meloidogyne incognita* on yield of cantaloupe and tobacco. *Nematol. medit., 11*: 169-174.

HARTMAN K. M. and SASSER J. N., 1985. Identification of *Meloidogyne* species on the basis of differential host test and perineal-pattern morphology, pp. 69-77. *In*: An advanced treatise on *Meloidogyne* (K. R. Barker, C. C. Carter and J. N. Sasser eds). North Carolina State University Graphics, Raleigh NC, USA.

HUSSEY R. S. and BARKER K. R., 1973. A comparison of methods of collecting inocula of *Meloidogyne* spp. including a new technique. *Plant Dis. Reptr., 57*: 1025-1028.

LAMBERTI F., 1979a. Economic importance of *Meloidogyne* spp. in Subtropical and Mediterranean climates, pp. 341-355. *In*: Root-knot nematodes (*Meloidogyne* species) systematics, biology and control (F. Lamberti and C. E. Taylor eds). Academic Press, London, U.K.

LAMBERTI F., 1979b. Chemical and cultural methods of control, pp. 403-423. *In*: Root-knot nematodes (*Meloidogyne* species) systematics, biology and control (F. Lamberti and C. E. Taylor eds). Academic Press, London, U.K.

TAYLOR A. L. and SASSER J. N., 1978. *Biology, identification, and control of root-knot nematodes* (Meloidogyne *species*), North Carolina State University Graphics, Raleigh NC, USA, 111 pp.

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