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EFFECT OF OLIVE POMACE SOIL AMENDMENT ON *MELOIDOGYNE INCOGNITA*

by
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Summary. The nematicidal effect of 0.5, 1, 2 and 5% w/w exhausted olive pomace soil amendment after 2, 4 and 8 weeks of decomposition in the soil was tested on *Meloidogyne incognita in vitro* and in the glasshouse. Juvenile emergence was reduced by 30% in leachates from soil amended with 5% olive pomace, with no difference among various degradation periods. Reproduction of *M. incognita* in the amended soil was significantly suppressed at all amendment rates, decreasing by 50% at the highest pomace rate.

Organic soil amendments have been shown to be effective for the control of plant parasitic nematodes (D'Addabbo, 1995). Various mechanisms are involved in this suppressive action (Stirling, 1991), although the release of toxic compounds and/or the modification of the soil microfauna and microflora were found to be the most relevant.

Important sources of organic matter are available from agro-industrial residues, including a large variety of vegetable and animal materials available at low cost. Moreover, the incorporation of such materials in the soil could be a possible solution to the problem of their disposal with no environmental pollution.

Olive pomace is a residue of the olive oil industry and is available in large quantities in southern Italy and generally in all of the Mediterranean basin. These residues are usually burnt without considering possible alternative uses, although recently local industries have tried to compost them for use as organic fertilizers.

Dry olive pomace combined with urea was found to suppress root galling caused by *Meloidogyne arenaria* on tomato (*Lycopersicon esculentum* L.), but was phytotoxic when used alone (Rodriguez-Kabana *et al.*, 1992). In another glasshouse experiment the addition of dry olive pomace treated with anhydrous ammonia to soil infested by *M. javanica* reduced galling on tomato roots (Rodriguez-Kabana *et al.*, 1994).

To ascertain the possible nematicidal effect to be derived from the addition of exhausted olive pomace to the soil on the root-knot nematode *M. incognita* (Kofoid *et* White) Chitw., two experiments were undertaken, respectively *in vitro* and in a glasshouse.

Materials and methods

A sterilized sandy soil was mixed with exhausted olive pomace at the rate of 0.5, 1, 2 and 5% w/w and put in 12 cm diam clay pots (750 cm^3 soil). Two, four and eight week decomposition periods of organic matter were allowed for each rate, during which soil was maintained in a glasshouse at 25 ± 2 °C and irrigated at daily intervals. There were six replicates for each combination of amendment rates and degradation periods.

In the first experiment soil was drenched by tap water and leachates from each treatment were collected separately at the end of each decomposition period. Batches of 25 egg masses of similar size (averaging 360 eggs), originating from an Italian population of *M. incognita* host race 1 (Taylor and Sasser, 1978), from sugarbeet (*Beta vulgaris* L.) (Castellaneta, Apulia), reared on tomato cv. Rutgers for two months in a glasshouse at 25 ± 2 °C, were placed on 2 cm diam sieves (215 µm aperture) and each sieve was put in a 3.5 cm diam Petri dish. Three ml of each leachate, sufficient to cover the egg masses, were then added. Distilled water was used as a control. The dishes were arranged in a complete randomized block design with four replicates of each treatment and incubated in a growth cabinet a 20 °C (Ekanayake and Di Vito, 1984). Emerged juveniles were removed and counted every week, renewing leachates at the same time, over a nine week period. At the end of the experiment the egg masses were plunged into a 1% sodium hypochlorite aqueous solution (Hussey and Barker, 1973) and the unhatched eggs were counted. Numbers of juveniles emerging weekly were expressed as cumulative percent of the total initial population.

In the second experiment one tomato seedling cv. Rutgers was transplanted in each pot at the end of each degradation period. After one week pots were inoculated with 10,000 eggs of *M. incognita* and arranged on benches in a glasshouse at 25 ± 2 °C in a randomized block design with six replicates for each treatment. Tomato plants were harvested 60 days after transplanting and the height, fresh and dry top and root weight were recorded. The final nematode population density in each pot was determined by processing 500 cm^3 soil by the modified Coolen's method (Coolen, 1979; Di Vito *et al.*, 1985) and separately each tomato root with a 1% aquous solution of NaOCl (Hussey and Barker, 1973). Eggs and juveniles in water suspensions were then counted, and the reproduction rate of the nematodes in each pot was calculated.

Data from both the experiments were statistically analyzed by factorial analysis of variance.

Results

In the first experiment hatching of *M. incognita* was negatively (P=0.01) affected by the products of degradation of olive pomace only at the highest amendment rate (Table I). In the leachates from 5% pomace amended soil less than 50% of juveniles emerged, with a 30% re-

TABLE I - *Percentage cumulative hatch of* Meloidogyne incognita *egg masses immersed in leachates from soil amended with exhausted olive pomace at different rates and after different decomposition times.*

Amendment rate (% w/w)	Degradation time (weeks)			Multiple comparisons on factor rate
	2	4	8	
0.0	76.7 b B	77.8 b B	75.8 b B	76.7 b B
0.5	76.6 b B	78.3 b B	77.9 b B	77.6 b B
1.0	76.8 b B	81.3 b B	77.6 b B	78.6 b B
2.0	77.5 b B	77.0 b B	78.0 b B	77.5 b B
5.0	42.9 a A	49.8 a A	51.0 a A	47.9 a A
Multiple comparisons on factor time	70.1 a A	72.8 a A	72.1 a A	

Data followed by the same letters on the columns are not significantly different according to factorial analysis of variance (small letters for $P=0.05$; capital letters for $P=0.01$).

TABLE II - *Effect of factor amendment rate on growth parameters of tomato (cv. Rutgers) and on nematode reproduction parameters in soil infested by* M. incognita *and amended with exhausted olive pomace.*

Amendment rate (% w/w)	Degradation time (weeks)				Nematode reproduction parameters	
	Height (cm)	Fresh top weight (g)	Dry top weight (g)	Root weight (g)	No. eggs/g roots (x 1,000)	*r* (*Pf/Pi*)
0.0	37.9 a A	40.1 bc BC	4.8 bc B	26.8 a A	54.5 c C	137.4 c C
0.5	38.5 a A	34.8 ab AB	4.1 ab AB	26.0 a A	38.8 b B	105.8 b BC
1.0	38.1 a A	43.5 c C	5.1 c B	26.5 a A	37.0 b B	95.7 b B
2.0	37.3 a A	31.5 a A	4.1 ab AB	27.3 a A	32.2 b B	86.6 b B
5.0	38.1 a A	29.6 a A	3.5 a A	24.9 a A	17.0 a A	48.7 a A

Data followed by the same letters on the columns are not significantly different according to factorial analysis of variance (small letters for $P=0.05$; capital letters for $P=0.01$).

TABLE III - *Effect of factor amendment decomposition time on growth parameters of tomato (cv. Rutgers) and on nematode reproduction parameters in soil infested by* M. incognita *and amended with exhausted olive pomace.*

Decomposition time (weeks)	Plant growth parameters				Nematode reproduction parameters	
	Height (cm)	Fresh top weight (g)	Dry top weight (g)	Root weight (g)	No. eggs/g roots (x 1,000)	*r* (*Pf/Pi*)
2	36.0 a A	33.5 a A	4.3 ab AB	28.3 b B	44.1 c B	127.5 b B
4	38.1 a AB	39.0 b A	4.9 b B	28.5 b B	26.2 a A	80.3 a A
8	39.8 b B	35.2 ab A	3.9 a A	22.2 a A	37.3 b B	76.6 a A

Data followed by the same letters on the columns are not significantly different according to factorial analysis of variance (small letters for $P=0.05$; capital letters for $P=0.01$).

duction compared to control. Differences were not significant among the three degradation periods.

In the second experiment growth parameters of tomato plants were not uniformly affected by the presence of olive pomace (Table II). Plant height and root weight did not differ significantly at the different amendment rates, whereas fresh and dry top weight showed a statistically significant (P=0.01) reduction at the highest rate. Comparisons made on factor time showed a significant (P=0.01) increase of plant height for eight weeks treatments compared to the control, associated with a reduction (P=0.01) of root weight (Table III).

Reproduction of *M. incognita* on tomato roots was clearly affected by the addition of olive pomace in the soil, as indicated by the number of eggs/g roots which was significantly (P=0.01) lower for all the amendment rates compared to the control (Table II). Moreover, in the soil with 5% pomace eggs/g roots were reduced by 50% in comparison with lower rates. The reproduction rate of the nematode confirmed previous results, as in 5% pomace-treated soil the final population was about 49% of the initial, and also at 1 and 2% rates of amendment the initial nematode population was significantly (P=0.01) suppressed, although not greatly, compared to unamended soil. Factor decomposition time only partially influenced the suppressive action of the pomace on the nematode (Table III): a two week decomposition period was not sufficient to prevent multi-

plication of *M. incognita*, but with a four week degradation the numbers of eggs on tomato roots were significantly (P=0.05) reduced. A longer degradation did not consistently increase the nematicidal action of olive pomace, as after eight weeks reproduction rates were reduced only slightly compared to four weeks.

Discussion

Results from both experiments demonstrated a suppressive effect of olive pomace, but not sufficient to prevent nematode attack of tomato plants. Nematode suppression was directly related to the amount of pomace added to the soil, as a consistent reduction of nematode populations was obtained at rates of incorporation higher than 2%. A four week degradation time of pomace in the soil was shown to be sufficient for an effective nematicidal action.

Addition of olive pomace did not affect the growth of tomato plants, although the significant reduction of plant top weight at the highest dosage reveals a possible phytotoxic effect, as already reported (Rodríguez-Kábana *et al.*, 1992, 1994).

The suppression of hatching of egg masses immersed in leachates from soil amended with the highest rate of pomace could be attributed to the release, although quantitatively inconsistent, of toxic metabolites derived from the decomposition of organic matter (Estaun *et al.*, 1985). The possibility that toxicity could be due to residues of the solvents used in the previous extraction of oil from pomace cannot be excluded.

Results from the second experiment, in which nematode suppression was much more evident also at low rates of amendment, could indicate that the effect of olive pomace is related to a modification of the soil microflora and/or microfauna (Stirling, 1991), with a prevalence of parasites and/or predators of *M. incognita*.

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