Nematol. medit. (1996), 24: 205-207

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THE EFFECT OF OLIVE POMACE SOIL AMENDMENT ON *HETERODERA CAROTAE*

by
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Summary. Two trials were undertaken *in vitro* and in the glasshouse to ascertain the effect of soil amendments with exhausted olive pomace on the carrot cyst nematode *Heterodera carotae*. Four different rates of application, 0.5, 1.0, 2.0 and 5.0% w/w and three different degradation periods, 5, 6 and 8 weeks, were examined. There was no effect in the *in vitro* test but there was a significant reduction of the nematode reproduction rate on carrot roots at the highest amendment dosages in the glasshouse experiment.

The nematicidal effect derived from the incorporation of organic amendments into the soil is widely reported (D'Addabbo, 1995). Moreover, the use of agro-industrial wastes as soil amendment could represent a possible solution to the problem of their disposal and avoiding environmental pollution.

Olive pomace is a residue of the olive oil industry, mainly in Mediterranean countries. When combined with urea or other nitrogen sources it suppressed root galling caused by root-knot nematodes (*Meloidogyne* spp.) on tomato (Rodríguez - Kabana *et al.*, 1992, 1995). In a glasshouse experiment on tomato, *M. incognita* was significantly suppressed in soil amended with exhausted olive pomace (D'Addabbo and Sasanelli, 1996).

Heterodera carotae Jones can cause severe damages to carrot in sandy soils of Southern Italy (Greco, 1986). Dosages of nematicides used in the control of this nematode could be reduced by combining them with alternative control methods such as soil solarization and/or organic amendments (Greco *et al.*, 1992).

Two preliminary experiments, *in vitro* and in a glasshouse, were undertaken to ascertain whether exhausted olive pomace at different rates of incorporation and after different decomposition periods in the soil had a nematicidal effect on *H. carotae*.

Materials and methods

In the first experiment exhausted olive pomace was added to a sterilized sandy soil to provide mixtures of 0.5, 1.0, 2.0 and 5.0% w/w. Clay pots (12 cm diam) were filled with the soil mixtures and each sown with carrot (*Dacus carota* L.) cv. 91. They were kept in a glasshouse at 20±2 °C for 3, 5 and 7 weeks after plant emergence, to obtain respectively 4, 6 and 8 weeks decomposition period of organic matter. There were six replicates for each combination of amendment rates and decomposition times. At the end of each decomposition period soil was drenched by tap water and root leachates collected separately for each amendment rate. The root leachates were then centrifuged at 1,300 rpm for 30 min, filtered through a filter paper, stored in plastic bottles and kept in a freezer until required. Small quantities for immediate use were kept in a refrigerator at 5 °C. Cysts from 200 g aliquots of

soil infested by *H. carotae* were extracted with a Fenwick can and incubated in the root leachates for ten weeks at 20 °C in a growth cabinet. There were four replicates for each treatment. Emerging juveniles were counted weekly and leachates renewed at the same time. At the end of the incubation period cysts were crushed and unhatched eggs counted to ascertain total number of eggs. The numbers of emerged juveniles were then expressed as per cent of total number.

In the second experiment olive pomace was mixed with a sandy soil from Margherita di Savoia (Foggia, Italy) infested by *H. carotae* (2 eggs/g soil) at the same rates as in the first experiment. Clay pots (12 cm diam) filled with the mixtures were kept in a glasshouse at 20±2 °C for 4, 6 and 8 weeks. There were six replicates of each treatment. At the end of the respective decomposition period the pots were sown with carrot cv. 91; ten days after emergence the plants were reduced to three per pot. Fifty days after emergence, aerial parts of plant were cut and the soil was left to dry in the pots for ten days to allow the cysts to detach from roots. Cysts were then extracted from the soil in each pot with a Fenwick can, separated from debris by the ethanol flotation method (Seinhorst, 1974), substituting the alcohol with a 1.25 sp. g. magnesium sulphate solution, and crushed, according to the Bijloo modified method (Seinhorst and Den Ouden, 1966). Eggs and juveniles/g soil were then counted. The reproduction rate of the nematode was expressed as per cent ratio between final and initial population of *H. carotae*.

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

Results and discussion

In the *in vitro* experiment, hatching from cysts immersed in root leachates from amended soil did not differ significantly from the control.

In the glasshouse experiment the reproduction rate of *H. carotae* was not significantly different from control in 0.5 and 1% pomace amended soil, but it was reduced by 34% ($P = 0.05$) at the 2% amendment rate (Table I). There was a highly significant ($P = 0.01$) suppression of nematode reproduction in soil with 5% olive pomace compared with the control and the 0.5 and 1% amendment rates and it was

TABLE I - *Reproduction rates of* Heterodera carotae *in soil amended with exhausted olive pomace at different rates and after different decomposition periods.*

Amendment rate (%)	Decomposition time (weeks)			Multiple comparisons on factor concentration
	4	6	8	
0	4.4 B b	5.2 B b	4.4 A b	4.7 B c
0.5	5.0 B b	4.9 B b	3.8 A ab	4.6 B c
1.0	5.1 B b	3.8 AB ab	3.9 A ab	4.2 B bc
2.0	3.1 AB ab	4.0 AB ab	2.2 A ab	3.1 AB b
5.0	0.9 A a	1.5 A a	1.5 A a	1.3 A a
Multiple comparisons on factor time	3.7 A a	3.9 A a	3.2 A a	

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

significantly ($P = 0.05$) lower than the 2% amended soil. Exhausted pomace did not cause phytotoxicity on carrot.

Multiple comparisons on factor time showed no statistical difference among the three decomposition periods.

The results indicate that soil amended with exhausted olive pomace is less effective in suppressing the reproduction of *H. carotae* than for *M. incognita* (D'Addabbo and Sasanelli, 1996) and requires higher dosages to provide a significant level of control. The suppressive action was not related to time of decomposition of the amendment in the soil.

The lack of any effect on cysts in the *in vitro* test, could indicate that nematode survival was not affected by the presence of toxic metabolites that result from degradation of the pomace (Estaún *et al.*, 1985). Therefore its suppressive effect might be due to the action of predators and/or parasitic microrganisms (Stirling, 1991) developing on the organic substrate, as confirmed by Rodríguez-Kabána *et al.* (1995) who observed an increase in microbial activity, as evident from increased soil esterase activity, in soil amended with olive pomace combined with various nitrogen sources.

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Accepted for publication on 4 May 1996.