Nematol. medit. (1999), 27: 257-260

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SUPPRESSION OF *XIPHINEMA INDEX* BY OLIVE AND GRAPE POMACE

by
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Summary. Suppressivity of 1, 2, 3, 4, 5 and 10% w/w olive and grape pomace soil amendment was tested on *Xiphinema index* on grapevine during a 18 months period in the glasshouse. Both amendments reduced nematode population more than 40% even at the lowest incorporation rate. The suppressive action of olive pomace reached its peak after six months, whereas the maximum effect of grape pomace was shown after one year.

Olive and grape pomace soil amendments have been shown to suppress root-knot nematodes (D'Addabbo and Sasanelli, 1996; 1998). These materials are largely available in Mediterranean countries, where *Xiphinema index* may also be widespread and the cause of severe damage to grapevines either directly or as a vector of viruses (Lamberti, 1990).

Several different mechanisms appear to be involved in the nematicidal action of organic amendments (Stirling, 1991) and they may be effective over a long time. A glasshouse experiment was undertaken over a period of eighteen months to ascertain the suppressive effects of soil amended with olive and grape pomace on the population dynamics of *X. index*.

Materials and methods

Olive and grape pomace were added to a steam sterilized sandy soil at different dosages (Table I). Plastic pots (1.2 l) were filled with mixtures and arranged on benches in a glasshouse at 25±2 °C, according to a randomized block design. There were ten replicates for each amendment dosage and unamended pots were used as control.

After a two week decomposition period one year old uniformly sized grapevine plants (*Vitis vinifera* D.C.) cv. Diamante were transplanted into each pot. One week later a suspension of 100 hand picked non-gravid young females of an Italian population of *Xiphinema index* Thorne *et* Allen was deposited in the rhizosphere of each plant.

The experiment was started on 30 December 1996 and was discontinued on 30 June 1998. During this period the plants were watered as needed and pots and blocks repositioned, to avoid plant and block position effect.

At six month intervals 200 ml aliquots of soil were collected from four pots of each treatment and nematodes were extracted by decanting and sieving (Brown and Boag, 1988) and counted. After counting, the nematodes from each aliquot were poured back on their respective pots.

At the end of the experiment the plants were uprooted and fresh top and root weight were recorded.

Because of the large variation in root damage, root systems were graded for severity of symptoms according to a 0-5 scale (Kunde *et al.*, 1968), where 0 = no symptoms; 1 = few localized swollen or curved tips; 2 = general swelling of root tips; 3 = deformation of the root system; 4 = deformation and reduction of the root system and 5 = heavy reduction of the root system and complete absence of feeder roots. Soil from each pot was thoroughly mixed and nematodes from 200 ml aliquots were extracted by decanting and sieving and counted.

All data were statistically analyzed by analysis of variance and means compared by Student's "*t*" and Duncan's multiple range tests.

Results

Top fresh weight of plants in soil amended with olive pomace was significantly higher than control only at dosages ≥40 g/Kg soil, whereas with grape pomace the difference was significant at 30 g/Kg soil. No statistical differences were observed between the two amendments at the same dosage (Table I). Root weight was not statistically affected by the presence of amendments.

Root gall index was significantly reduced by the addition of both amendments at all the combination rates, and there were differences among the different dosages. At the same amendment rate, the root gall index was always lower in olive than in grape pomace.

The population density of *X. index* was significantly reduced in all of the treatments, but there were no differences between the amendments at the same dosage (Table II).

At the first sampling date the population of *X. index* was significantly reduced by all rates of olive pomace, whereas grape pomace was not suppressive at the two lowest rates. Both amendments showed no difference among dosages ≥30 g/kg soil, with the exception of 100 g/kg soil grape pomace.

After one year, all treatments showed nematode populations significantly lower than the control. Rates ≥20 kg soil of the two amendments were not statistically different between them.

TABLE I - *Growth of grapevine cv. Diamante in soil infested by* Xiphinema index *amended with olive and grape pomace at different dosages.*

Treatment		Top fresh weight (g)	Root weight (g)	Root gall index
Amendment	Dosage (g/kg soil)			
Control	–	14.6 a A	48.2 a A	4.3 a A
Olive pomace	10	17.2 ab AB	52.8 ab A	3.1 b B
Grape pomace	10	18.3 ab AB	57.1 ab A	2.9 b BC
Olive pomace	20	21.1 abc AB	51.3 ab A	2.0 cd D
Grape pomace	20	17.3 ab AB	52.7 ab A	3.1 b B
Olive pomace	30	20.9 abc AB	54.5 ab A	1.4 de DE
Grape pomace	30	23.0 bc AB	58.1 ab A	2.1 c CD
Olive pomace	40	23.0 bc AB	59.3 ab A	1.1 ef EF
Grape pomace	40	23.3 bc B	59.3 ab A	2.0 cd D
Olive pomace	50	22.9 bc AB	56.6 ab A	0.8 ef EF
Grape pomace	50	22.4 bc AB	56.0 ab A	1.9 cd D
Olive pomace	100	23.2 bc B	56.9 ab A	0.6 f F
Grape pomace	100	25.6 c B	65.1 b A	0.9 ef EF

Values followed by the same letter on the same column are not significantly different (small letters for P=0.05; capital letters for P=0.01), according to Duncan's multiple range test.

TABLE II - *Dynamics of population of* X. index *on grapevine cv. Diamante in soil amended with olive and grape pomace at different dosages (Pi=100 non gravid females/pot).*

Treatment		Population of *X. index* (Females and juveniles/ml soil)					
Amendment	Dosage (g/kg soil)	P_1 (30/06/97)	$t^{(2)}$	P_2 (30/12/97)	t	P_f (30/06/98)	t
Control	–	19.4 a A	**	41.5 a A	*	47.9 a A	–
Olive pomace	10	10.3 bcd BCD	**	14.9 bc BC	*	28.8 b B	*
Grape pomace	10	14.8 abc ABC	**	17.3 b B	–	28.2 b B	*
Olive pomace	20	10.6 bcd BCD	**	2.4 ef D	*	13.9 c C	*
Grape pomace	20	15.4 ab AB	*	3.5 def D	*	14.3 c C	*
Olive pomace	30	3.8 efg DEF	–	1.1 ef D	–	11.2 cd C	**
Grape pomace	30	11.6 bcd BC	**	9.9 cd BCD	–	11.3 cd C	–
Olive pomace	40	3.4 efg DEF	–	0.9 ef D	**	5.3 cd C	–
Grape pomace	40	11.8 bcd BC	*	8.0 cde CD	–	15.1 c C	–
Olive pomace	50	0.6 g F	–	0.4 f D	–	2.6 d C	**
Grape pomace	50	11.7 bcd BC	*	3.6 def D	–	6.6 cd C	–
Olive pomace	100	2.8 fg DEF	–	0.4 f D	–	3.1 d C	*
Grape pomace	100	2.1 fg EF	–	2.0 ef D	–	7.0 cd C	–

(1) Data followed by the same letter on the same column are not significantly different (small letters for $P=0.05$; capital letters for $P=0.01$), according to Duncan's multiple range test;
(2) Significantly different from the previous population density, according to the Student's t test (* for P=0.05; ** for $P=0.01$).

By the end of the experiment the population of *X. index* had been significantly reduced at all rates of olive or grape pomace, with no difference between the amendments at the same dosage or among dosages >10 g/kg soil.

In soil amended with olive or grape pomace at 10 g/kg soil the nematode population increased significantly during the period of the experiment, whereas no statistical variations were found among sampling dates at all the other dosages of olive pomace and at 50 and 100 g/kg soil grape pomace.

Rates of 20 and 40 g/kg soil grape pomace reduced *X. index* density in the soil during the first year, after which population increased.

The analytical relationship between amendment dosage and *X. index* population was derived from the experimental data, with the high correlation index and level of significance given by the logarithmic equation (Fig. 1): $y = m\ln(x+1) - b$ (1), in which y is the *X. index* population and x the dosage of the amendment. From the equation, the reduction of *X. index* population density caused by amending the infested soil with a known dosage of olive or grape pomace can be estimated.

Discussion

Both the amendments confirmed a suppressive action on *X. index* which is similar to that previously reported on root-knot nematodes (D'Addabbo and Sasanelli, 1996; 1998). However, *X. index* appeared to be more susceptible than *M. incognita*, final populations were reduced by more than 40% even at the lowest amendment rate. Incorporation of a 30 g/kg soil appeared to be sufficient to obtain the maximum suppressive effect with both the amendments, as no significant variations were found at higher rates.

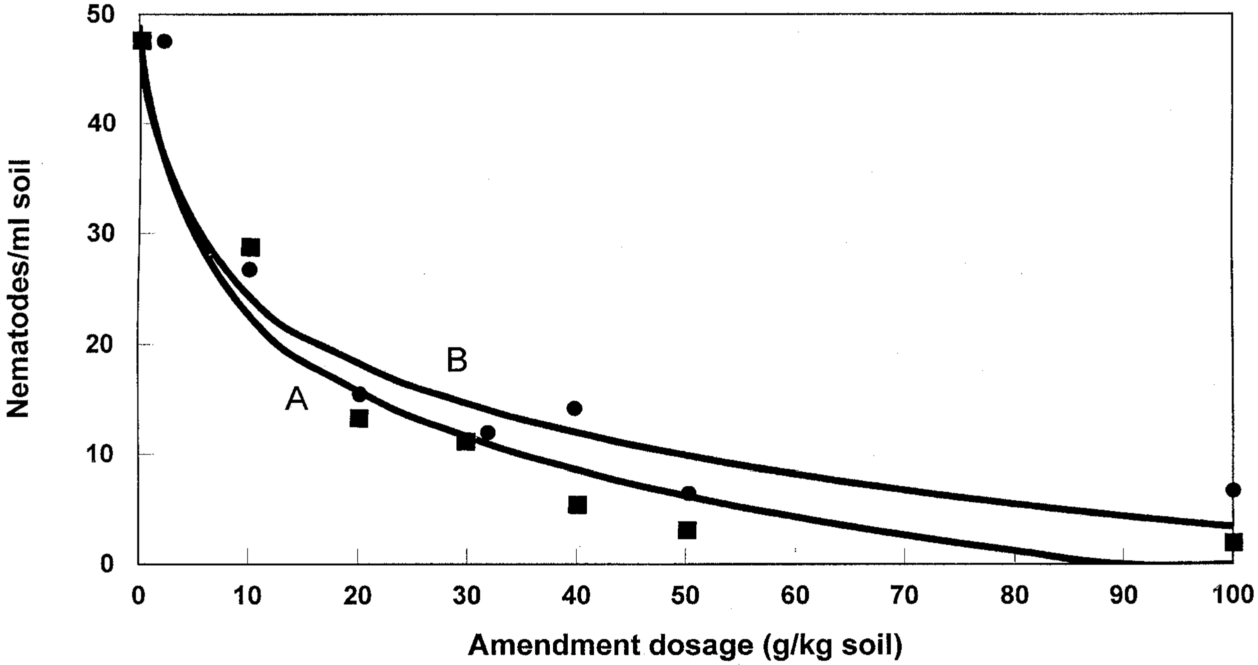

Fig. 1 - Relation between dosage of olive (A ■: $y=48.81-10.83\ l_n\ (x+1)$; $r=-0.975$ for $P=0.01$) and grape (B ●: $y=47.43-9.54\ l_n\ (x+1)$; $r=-0.971$ for $P=0.01$) pomace and *Xiphinema index* population on grapevine cv. Diamante.

Plant growth enhanced by grape pomace could be due to the combination of the suppressive effect on nematodes with a direct fertilizing effect on plants, as observed in previous trials on tomato. Conversely, growth increase associated with olive pomace should be attributed only to the suppression of nematode populations, as high rates of this amendment were previously found to be phytotoxic (Rodriguez-Kabana *et al.*, 1992).

Olive pomace was effective within a few months after addition to the soil, whereas grape pomace was slower in its effect, reaching its peak after one year. The more rapid suppressive effect of olive pomace could be due to the release of toxic products, whereas the effect of grape pomace may be due to a slow modification of the soil microflora, and more specifically to the development of predators and parasites of *X. index* on the organic substrate.

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Accepted for publication on 11 June 1999.