SUGARCANE RESIDUES SOIL AMENDMENTS FOR CROP IMPROVEMENT AND CITRUS NEMATODE *TYLENCHULUS SEMIPENETRANS* MANAGEMENT ON MANDARIN UNDER SANDY (CALCAREOUS) SOIL CONDITIONS

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Abstract

Sugarcane residue soil amendments for crop improvement and citrus nematode, *Tylenchulus semipenetrans* management on mandarin were studied under sandy (calcareous) soil conditions. Molasses and vinasse as sugarcane residues each was applied twice compared to the nematicide, oxamyl 24% L on March and 60 days after the first application (on May) at 1/10 and 1/20 dilutions. The two tested materials significantly ($P \leq 0.01$ and 0.05) decreased nematode population in soil and root especially at midseason by 97.7 % and 97.3 % for molasses and vinasse at the highest concentration, respectively. At harvest stage, the nematode population especially at the lowest concentration of both materials tended to build up again compared to the untreated check. The two tested materials resulted in 80.8 and 69.2 % increases in fruit yield per feddan for molasses and vinasse at the highest concentration, respectively.

INTRODUCTION

The citrus nematode, *Tylenchulus semipenetrans* Cobb is considered to be the most serious nematode parasite on citrus trees especially in the newly reclaimed soil (Duncan & Cohn, 1990). Methods commonly practised to control citrus nematode focus on excluding this pest from soil and minimizing yield losses through crop management using organic amendments (Giginejsvili & Meladze, 1967, O'Bannon, 1968, Pinckard, 1972 and Amin & Youssef, 1997). The benefits of amending soil with some sugarcane organic residues such as molasses were recognized many years ago in the sugarcane industry where it was providing greater benefits to the crop in addition to nutrition for reducing damage to roots caused by root parasites (Anonymous, 1939 and Story, 1929). Vawdrey and Stirling (1997) observed a reduction in severity of root galling in tomato when molasses was added to soil comparable to that of nematicide, phenamiphos. Schenck (2001) reported that molasses lowered population of reniform nematode in a papaya plantation and resulted in a marked improvement in the tree growth and harvestable fruit. Thus, the

purpose of this research is to describe the effect of certain sugarcane residues viz., molasses and vinasse on population of citrus nematode, *T. semipenetrans* and yield of mandarin tree under sandy calcareous soil conditions.

MATERIALS AND METHODS

This experiment was conducted in newly reclaimed sandy (calcareous) soil infested with citrus nematode, *Tylenchulus semipenetrans* at El-Khatatba, Beheira Governorate throughout the growing season of 15-years-old mandarin, *Citrus reticulate*, on sour orange rootstock. Chemical analysis of the tested soil was illustrated in Table 1. The applied treatments were as follows: (1) Molasses and vinasse each at dilutions of 1: 10 and 1: 20 (1 liter molasses or vinasse per 10 and 20 liter water) at the rates of 2 and 4 Liter solutions / tree , respectively. (2)Oxamyl 24%L at the rate of 3 liter/feddan (15 ml/ tree) and (3) Untreated check. Constituents of the tested materials are illustrated in Table 2. These treatments were applied at the beginning of this study March, 2003 and again 60 days (in May) after the first application. Each treatment was replicated five times and arranged in a completely randomized block design. Each tree soil and roots were sampled just before application in March, before the second application in May and at the harvest stage in December. A sainple of 200 g soil per replicate was processed for nematode extraction by using sieving and decanting methods. Nematode juveniles in 5 g roots from each replicate were extracted by incubation as described by Young (1954). Fruit yield per feddan (feddan = 4200 m2) was estimated for each treatment by multiplying the total fruit yield in kg per / tree by the number of trees per feddan (about 200 trees / feddan).

RESULTS

Data in Table 3 indicated that the tested sugarcane residues viz., molasses and vinasse significantly ($P \leq 0.01$ and 0.05) affected soil and root population densities of citrus nematode, *Tylenchulus semipenetrans* on mandarin trees especially at midseason, 60 days after the first application in May. In other words, the highest percentages reduction of *T. semipenetrans* (J2) was evidently obtained by the highest concentration of both tested materials as they were 97.7 and 97.3 % for molasses and vinasse, respectively. The lowest concentration of both materials achieved 85.9 and 80.3 %, for the respective treatments. The nematicide, oxamyl caused 96.4 % nematode reduction. At harvest stage in December, the population of *T. semipentrans*

tended to increase again at the lowest concentration of both materials compared to that of untreated check. Table 4 showed that the number of fruits and fruit yield per tree and fruit yield per feddan significantly ($P \leq 0.01$ and 0.05) increased parallel to the nematode reduction. Accordingly, the highest percentages yield in ton increases were recorded at the highest concentration of both materials as they were 80.8 and 69.2 % for molasses and vinasse, respectively. The nematicide, oxamyl achieved 44.2 % increase only.

DISCUSSION

The dual effect of the additive certain sugarcane residues viz., molasses and vinasse in increasing yield of mandarin and in management of the citrus nematode, *T. semipenetrans* is verified. The effect of molasses and vinasse on mandarin trees was probably due, besides nematode control, to other factors such as change in nutritional balance of the soil, in soil structure and in soil microbial populations. In other words, as suggested by Schenck (2001), molasses provides a carbon source which alters C/N ratio in soil and this affects the soil microbiota which in turn affects the available nutrients. Also, the same author suggested that the suppressant effect of molasses on nematodes may probably due to antagonists of microorganisms, to change in oxygen concentration due to microbial metabolism of molasses, or to the release of toxic compounds from decomposing molasses. He added that organic amendments such as molasses do not pose a threat to the environment that chemical pesticides do, since they are readily decomposed in soil to Co_2 and harmless by-products. Certain mematicides were reported to decrease *T. semipenetrans* (Timmer & French, 1979, Eissa & Moussa, 1981 and Amin & Youssef, 1997).

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Table 1. Chemical analysis of the tested soil.

Soil type / texture	Chemical analysis Meq / 100 soil Cations K+	Na+	Mg+	Ca++	Anions So_4^-	Cl^-	Hco_3^-	% $Caco_3$	% Organic Matter	EC m-mhos per cm
Sandy / Calcareous	3.06	25.50	20.04	32.66	42.22	36.48	2.86	6.69	3.40	7.50

EC = Electrical conductivity

Table 2. Constituents of sugarcane molasses and vinasse.

Constituents	Molasses (%)	Vinasse (%)
Dry mater	85.0	47.5
Moisture	15.0	52.5
Total sugar	62.0	3.5
Ash content	10.0	15.0
Protein content	4.5	11.5
Potassium (as k_2o)	3.8	5.0

Table 3. Influence of some sugarcane residues and a nematicide on *Tylenchulus semipentrans* infesting mandarin under calcareous soil conditions.

Treatments	Nematode counts / 200 g soil & 5 g roots Pi	Pm	% Red.	Pf	% Red.
Molasses at 1 : 20	388	3813	80.3	5488	+265.8
1 : 10	259	298	97.7	946	5.0
Vinasse at 1 : 20	254	1787	85.9	1627	+65.3
1 : 10	465	639	97.3	625	65.4
Oxamyl 24% L	941	1699	96.4	1351	62.7
Untreated check	124	5206	-	480	-
L.S.D. 5%			38.02		
L.S.D. 1%			151.4		

Values are averages of five replicates.

Pi = Initial population, Pm = Population at mid season and Pf = Final population

+ =Increase over untreated check

Red. % = % Nematode reduction (% efficiency) according to Handerson & Tilton

$$\text{Formula} = \left(1 - \frac{\text{Population in treated plots after application}}{\text{Population in the treated plots before application}} \times \frac{\text{Population in check before application}}{\text{Population in the check after application}}\right) \times 100$$

(Puntener, 1981.)

Data were log-transformed as $\log_{10}(X + 1)$ before statistical analysis and original figures were recorded.

Table 4. Effect of some sugarcane residues on mandarin production in sandy (calcareous) soil.

Treatments	Fruit number per tree	% Inc.	kg / tree	% Inc.	Fruit yield ton / feddan	% Inc.
Molasses at 1 : 20	355	51.7	39.4	51.5	7.9	51.9
1 : 10	424	81.2	47.1	81.2	9.4	80.8
Vinasse at 1 : 20	306	30.8	34.0	30.4	6.8	30.8
1 : 10	394	68.4	43.8	68.5	8.8	69.2
Oxamyl 24% L	339	43.6	37.3	43.5	7.5	44.2
Untreated check	234	-	26.0	-	5.2	-
L.S.D 5%	100.2		10.9		2.1	
L.S.D 1%	135.9		14.8		2.9	

% Inc. = % increase over untreated check.

مكافحة نيماتودا المولح *تيلنكيولس سيميبنترانس* علي أشجار اليوسفي باستخدام بعض مخلفات قصب السكر تحت ظروف التربة الرملية (الجيرية)

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تم استخدام المولاس و الفيناس كمخلفات لنبات قصب السكر من أحد مصانع السكر بتخفيفات ١ : ١٠ & ١ : ٢٠ من كل منهما لمكافحة آفة نيماتودا التدهور البطيء في المولح تيلنكيولس سيميبنترانس علي أشجار اليوسفي بالمقارنة بالمبيد النيماتودي اوكساميل ٢٤ % سائل تحت ظروف التربة الرملية (الجيرية) في منطقة الخطاطبة – محافظة البحيرة . و قد تم تطبيق هذه المواد في بداية موسم النمو في مارس ٢٠٠٣ ثم كررت نفس المعاملات بعد ٦٠ يوم من المعاملة الأولى في مايو من نفس العام. و قد أدى استخدام المولاس و الفيناس في التركيزات العالية و كذلك المبيد النيماتودى إلى خفض معنوي(١ % ، ٥ %) في الكثافة العددية لنيماتودا المولح في منتصف الموسم بنسبة ٧و٩٧ ، ٣و٩٧ ، ٤و٩٦ % علي الترتيب. و في موسم الحصاد بدأت أعداد هذه الآفة في الزيادة مرة ثانية خصوصا في التركيزات المنخفضة من المولاس و الفيناس بالمقارنة للأشجار الغير معاملة ، كما أدى استخدام المواد السابقة إلى زيادة معنوية (١% ، ٥%) في محصول الثمار بنسبة ٨و٨٠ & ٢و٦٩ % في التركيزات العالية للمولاس و الفيناس علي الترتيب و بنسبة ٢و٤٤ % بالنسبة للمبيد النيماتودي اوكساميل. و هذه الطريقة تعتبر آمنة و غير ملوثة للبيئة حيث تتحول هذه المواد إلى غاز ك ٢١ و لذلك ينصح باستخدامها في مجال المكافحة المتكاملة.