EFFECT OF FOUR COMPOSTS ON *MELOIDOGYNE INCOGNITA* AND *FUSARIUM SOLANI* INFESTING SUPERIOR GRAPEVINE AND THEIR INFLUENCE ON YIELD PRODUCTION AND QUALITY

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Summary. Four commercial composts (El-Wady®, El-Kattamyia®, Bio-green® and Organic Complementary®) prepared from food industry residues, town refuse organic matter, poultry droppings and sugar cane residues, respectively, were tested for their efficacy in suppressing root knot and root rot diseases caused by *Meloidogyne incognita* and *Fusarium solani*, respectively. The two pathogens were found infesting ten-year-old grapevines cv. Superior planted in newly reclaimed sandy soil under a drip irrigation system. The impacts of the composts were studied on plant growth variables and yield production when incorporated into the soil at the rates of 1.5, 3.0 and 6.0 kg/grapevine plant during two successive seasons (2007 and 2008). The addition of composts to soil significantly suppressed populations of the root-knot nematode in soil and roots as well as gall formation, with Organic Complementary compost being the most effective in controlling second stage juveniles of *M. incognita* in soil and roots, followed by El-Wady, Bio-green and El-Kattamyia composts, respectively. The greatest suppression of root galls was exhibited by Bio-green compost followed by Organic Complementary, El-Kattamyia and El-Wady composts, respectively. All composts and doses significantly suppressed *F. solani* in soil and enhanced soil mycoflora, which was composed of *Aspergillus niger*, *A. terreus*, *Penicillium chrysogenum*, *P. citrinum* and *P. corylophilum*, and decreased the infection of new grapevine roots by *F. solani*. All composts enhanced plant leaf area and cane thickness, increased nitrogen, phosphorous and potassium content of leaves and improved both physical and chemical characters of clusters and berries. Total soluble solids (TSS), Total acidity (TA), TSS/TA ratio and grape yield were also increased.

Keywords: Compost, control, root-knot nematode, *Fusarium* wilt, *Vitis vinifera*.

Grapevine (*Vitis vinifera* L.) is one the most widely cultivated fruit crops in the world. In Egypt, grapevine ranks second after citrus among fruit crops. Superior seedless is one of the newly introduced grapevine cultivars in Egypt. It is an early cultivar that meets the requirements of local as well as of foreign markets, such as that of some Arabic and European countries. The area cultivated to grapevine is of about 13,060 feddans (= 5,441 hectares) in the newly reclaimed land (Anonymous, 2006). Among pests and pathogens associated with grapevine in Egypt, *Meloidogyne incognita* (Kofoid *et* White) Chitw. and the soil-borne fungus *Fusarium solani* (Mart.) Appel *et* Wollenw. emend. Snyd. *et* Has are causing severe root-knot and root-rot diseases, respectively, which are of great economic significance (El-Nagdi and Youssef, 2004; El-Gendy and Shawky, 2006).

A major problem in modern agriculture is the systematic use of chemical pesticides, which not only raises production costs but also leads to environmental pollution. Control of soil-borne pathogens is difficult because they have peculiar ecological behaviour, extremely broad host ranges and high survival rates of populations resistant to pesticides (Yangui *et al.*, 2008). In addition, resistant cultivars of grapevine suitable for Egyptian conditions are not available. It is, therefore, important to develop alternative approaches/materials to manage grapevine diseases, due to concern over synthetic pesticide residues on fruit and the development of pathogen resistance. Composts have been used for centuries to maintain soil fertility, plant health and enhance water-holding capacity of soil. Also they are an important source of macro and micro elements and they increase soil organic matter content, thus leading to increased crop yield (Kassem and Marzouk, 2002).

The effectiveness of composts in controlling soil-borne plant diseases is well known (Hoitink and Fahy, 1986; Muhammad and Amusa, 2003). The effects of composts on plant parasitic nematodes have not been studied as thoroughly as their effects on fungal diseases. Some authors have reported suppression of root-knot nematodes by composted agricultural wastes (McSorley and Gallaher, 1997; Oka and Yermujaha, 2002; Kimpinski *et al.*, 2003; Nico *et al.*, 2004; Oka *et al.*, 2007). Suppression of *Fusarium* spp. by application of composts has also been reported (Steinberg *et al.*, 2004; Trillas-Gay *et al.*, 2006). Moreover, Fujiwara (1996) and Jonathan *et al.* (2000) reported that application of composts to grapes stimulated root growth, increased leaf area, and improved fruit colour, weight and sugar content. However, not all composts are disease-suppressive due to the variability in compost sources and composting processes.

The objectives of this study were to determine the potential of four commercial composts, locally prepared by Egyptian companies from various residues, in the suppression of root-knot disease caused by *M. incognita* and root-rot disease caused by *F. solani* in grapevines cv.

Superior, grown in newly reclaimed sandy soil fields, as well as their impacts on crop productivity, leaf mineral content and fruit quality.

MATERIALS AND METHODS

Experimental plots and treatments design

The study was conducted during two successive seasons (2007 and 2008) in 10-year-old grapevine cv. Superior infested fields, under a drip irrigation system at El-Esraa and El-Mearag village located in El-Nubaria district, Behera governorate, Western Nile Delta region, Egypt. The composts evaluated were; *i*) El-Wady compost (EWC®) prepared from food industry residues with C/N ratio 18:1; *ii*) El-Kattamyia compost (EKC®), prepared from town refuse organic matter with C/N ratio 18:1; *iii*) Bio-green compost (BGC®), prepared from chicken droppings with C/N ratio 20.9:1, and *iv*) Organic Complementary compost (OCC®) prepared from sugar cane residues with plant inessential metallic addition and C/N ratio 15.8:1. EWC, EKC and BGC were manufactured by Delta Bio-tec Company and OCC by Sugar Cane and Industry Complementary Company. The results of their chemical analyses are reported in Table I. Grapevines were planted at 3 × 3 m spacings and were pruned each season during the third week of January, leaving approximately six fruit canes and ten buds/cane (60 buds/grapevine). The soil had organic matter 0.9%, pH 8.2, E.C. 0.38 dsn^{-1}, $CaCo_3$ 1.6%, P 0.1%, K 7.5% , Zn 1.9 ppm, Mn 10.4 ppm, and Fe 4.0 ppm.

Three doses (1.5, 3.0 and 6.0 kg/grapevine) of the mentioned composts were incorporated into the soil around each grapevine up to 50 cm from trunk and to a depth of 20-30 cm, in the first week of March of each growing season. The experiment was arranged according to a completely randomized design. Seventy-eight grapevines (twelve treatments and a non amended control, each replicated six times), nearly uniform in vigour, were randomly selected.

Soil and root samples from each replicate were collected within 50 cm of the trunk, in the grapevine rhizosphere, to a depth of 20-30 cm. Each sample was a composite of four cores (5 cm diameter) and averaged 800 g soil (200 g soil per core) and 20 g root per plant (about 5 g per core). Samples were collected once before compost application and at monthly intervals during April, May and June (harvest time) of each season. Grapevines received traditional agricultural practices without addition of any nematicides or mineral fertilizers.

Identification of Meloidogyne *spp*. Adult females were isolated from galled roots of grapevine and identified as *M. incognita* by examination of their cuticular perineal patterns and morphological characteristics according to Taylor and Sasser (1978).

Isolation of F. solani *from grapevine roots*. Root samples collected before treatments were transferred to the laboratory, surface sterilized by dipping in 2% sodium hypochlorite solution for 2 min. and then washed several times in sterile distilled water. Then, they were dried between two filter papers, plated on PDA medium, and incubated at 25 °C for 7 days to detect the presence of *F. solani* according to isolation procedures described by Dhingra and Sinclair (1985) and Raviv *et al*. (2005). Identification of *F. solani* was based on morphological and culture characteristics (Nelson *et al*., 1983).

Effects of composted soil on M. incognita. Each soil sample was thoroughly mixed and an aliquot of 200 g was processed for nematode extraction by a sieving and centrifugation technique (Barker, 1985). The extracted nematodes were counted by using 1 ml Peters' counting slides under a stereo-microscope (100×). Root samples of each replicate were carefully washed free from adhering soil and gall numbers were counted. Then they were cut into 2-cm-long pieces, mixed, and a 5 g sub-sample put in a Baerman pan with clean fresh water and incubated under laboratory conditions (25 ± 5 °C) for a week to ex-

Table I. Chemical analysis of the four tested composts.

Chemical analysis	Compost			
	El-Wady (EWC)	El-Kattamiya (EKC)	Bio-green (BGC)	Organic Complementary (OCC)
Organic matter %	58	48.3	48.3	40.3
Organic carbon %	25.2	25.2	27.2	20.5
Nitrogen %	1.4	1.4	1.3	1.3
C/N	18:1	18:1	20.9 :1	15.8:1
pH	6.6	7.6	8.5	7-6.5
Potassium %	0.76	-	1.21	2-3
Sulphur %	-	-	-	2-3
Phosphorus %	0.6	0.69	0.81	4-5

tract *M. incognita* J_2 according to Southey (1970), which were then counted. Before statistical analysis, the numbers of nematodes were normalised by logarithmic transformation. Percentage reduction of the J_2 population in soil and galled roots was determined according to the formula of Handerson and Tilton (Puntener, 1981):

$$\text{Nematode reduction (\%)} = 1\text{-}(PTA/PTB \times PCB/PCA) \times 100$$

In this equation PTA = Population in the treated grapevines after application, PTB = Population in the treated grapevines before application, PCB = Population in the check grapevines before application, PCA = Population in the check grapevines after application.

Effect of composted soil on soil mycoflora. Populations of *F. solani* and other mycoflora in soil from treated and untreated grapevine rhizospheres, during April, May and June, were determined as numbers of colony forming units (CFU) in one ml of soil suspension cultured on potato-dextrose agar (PDA) medium by the poured plate method and dilution technique (Ghini *et al.*, 2007). Thus, one gram of soil was suspended in 99 ml sterile water to obtain a 1/100 dilution. Then, serial dilutions were prepared up to 10^{-5}. Three replicated plates were prepared for each dilution per soil sample. The plates were incubated at 25 °C for 7 days. Fungi that grew out were counted as CFU/plate and identified to species level according to morphological and culture characters (Gilman, 1957; Barnett and Hunter, 1972; Nelson *et al.*, 1983). Each isolated fungus was counted and its frequency percentage calculated (Tables V and VI) according to the equation:

$$\text{Frequency percentage} = \text{Fungus no./ Total fungi no.} \times 100$$

Detection of F. solani *in new roots***.** New root samples were taken from treated grapevine as well as from untreated grapevine during April, May and June and examined for the presence of *F. solani* according to the isolation procedures mentioned before.

Effects of compost application on plant growth and yield

The following determinations were made on the second week of June of each growing season.

Vegetative growth. To determine leaf area, samples of mature leaves (4^{th}-6^{th} leaf) were taken from non-fruit-bearing shoots of each treatment. The area was estimated according to the formula of Sourial *et al.* (1985):

$$\text{Leaf area} = \frac{3.14 \times (\text{diameter})^2}{4}$$

Cane thickness. This was measured at the end of each growing season on six canes at 5 cm from the main branch in each replicate.

Leaf mineral contents. Total nitrogen (N), phosphorous (P) and potassium (K) contents were determined in oven-dried leaves (leaves opposite to clusters) according to the methods described by Naguib (1969), Kitson and Mellon (1964) and Brown and Lilleland (1946), respectively. The concentrations of the microelements iron (Fe), manganese (Mn) and zinc (Zn) were determined according to the method described by Jackson and Ulrich (1959).

Fruits. To determine physical characters, three clusters from each replicate (eighteen clusters/treatment) were taken at harvest to determine cluster weight, berry weight/cluster, rachis weight and cluster compactness (berry weight/length). The quality of berries in terms of berry weight, berry length (L), berry diameter (D) and berry shape (L/D) was also assessed.

For chemical characteristics, samples of 50 berries were randomly chosen from each replicate to measure the total soluble solids (TSS%) in the fruit juice, using a hand refractometer. Total acidity (TA%) was determined as outlined in A.O.A.C. (1985) and the TSS/TA ratio was calculated.

At harvest time, the yield was estimated on the basis of number and weight of clusters/grapevine for each treatment.

Statistical analysis

Data were subjected to analysis of variance using Computer Statistical Package (CO-STATE) User Manual Version 3.03, Barkley Co., USA, and mean values compared by the Least Significance Difference (LSD) test at P = 0.05 level of significance (Snedecor and Cochran, 1980). Nematode data were normalised before analysis by log transformation.

RESULTS

Effects of composts on root knot nematode population

All composts and rates significantly suppressed *M. incognita* populations in soil and grapevine roots and in general numbers of root galls throughout the growth seasons (Tables II-IV). The composted soil reduced the nematode population in soil by 48 to 96% during 2007 season and by 47 to 98% during 2008 (Table II). Incorporation of OCC (Table II) induced the greatest percentage reductions in *M. incognita* J_2 in soil, which were 92, 96 and 95% for the rates of 1.5, 3.0 and 6.0 kg/grapevine at the end of the first season and 95, 96 and 98%, respectively, at the end of the second season. This was followed by the EWC, BGC and EKC treatments, respectively.

The same reduction trend was observed for numbers of *M. incognita* J_2 in the roots (Table III). The composted soil reduced the numbers of nematodes in roots of grapevine from 27 to 91% during 2007 season and from 29 to 94% during 2008 (Table III). The percentage re-

Table II. Effect of composted soil on log nematode densities and reduction (%) of the root-knot nematode, *Meloidogyne incognita* J_2, in soil cropped to Superior grapevines (2007 and 2008 seasons).

Compost		Initial nematode population (J_2/ 200 g soil) log x		log x of numbers of nematodes in amended soil and reduction (Red.) (%) of juveniles in soil in the first week of:											
				April				May				June			
				2007		2008		2007		2008		2007		2008	
Name	Rate (kg /grape-vine)	2007	2008	log x	Red. %	log x	Red. %	log x	Red. %	log x	Red. %	log x.	Red. %	log x	Red. %
El-Wady (EWC)	1.5	2.9	2.5	2.4 d	66 f	2.0 d	76 d	2.5 c	59 d	2.5 c	80 f	2.3 b	76 f	1.7 d	91 e
	3.0	3.0	3.1	2.4 d	77 c	2.2 c	89 b	2.2 e	84 b	2.5 c	87 d	2.2 c	88 cd	2.2 c	93 cd
	6.0	2.7	2.7	2.0 e	80 b	2.2 c	73 e	1.9 g	86 b	1.7 h	95 a	1.9 e	90 bc	1.7 d	94 bc
El-Kattamiya (EKC)	1.5	2.3	2.0	2.0 e	61 g	1.5 h	72 e	1.5 i	48 d	1.9 f	47 i	1.9 e	71 g	1.6 e	74 i
	3.0	2.3	2.2	1.8 f	81 b	1.9 e	53 i	1.7 h	80 c	1.4 j	89 b	1.7 f	81 e	1.7 d	80 g
	6.0	3.2	3.2	2.5 c	82 b	2.2 c	93 a	2.3 d	90 a	2.6 b	83 e	2.0 d	95 a	2.3 b	92 de
Bio-green (BGC)	1.5	2.3	2.3	1.8 f	65 f	2.0 d	58 h	1.5 i	84 b	1.5 i	75 g	1.5 h	87 d	1.3 i	95 b
	3.0	2.2	2.3	1.6 h	73 d	1.6 g	63 g	1.4 j	86 b	1.8 g	62 h	1.4 i	88 cd	1.2 j	92 de
	6.0	2.3	2.3	1.7 g	74 d	1.7 f	70 f	1.4 j	86 b	2.2 e	81 f	1.4 i	89 cd	1.5 f	89 f
Organic Complementary (OCC)	1.5	3.1	3.3	2.7 b	70 e	2.6 b	82 c	2.6 b	78 c	2.6 b	87 d	2.2 c	92 b	2.2 c	95 b
	3.0	2.7	2.6	1.8 f	89 a	1.9 e	90 b	2.1 f	78 c	1.9 f	87 d	1.6 g	96 a	1.4 h	97 a
	6.0	3.1	3.1	2.5 c	78 c	1.9 e	94 a	2.1 f	91 a	2.4 d	88 cd	1.9 e	95 a	1.6 e	98 a
Control		2.9	2.9	2.9 a	-	2.9 a	-	3.0 a	-	3.0 a	-	3.0 a	-	3.1 a	-

Means in each column followed by the same letter are not significantly different according to LSD test (P = 0.05).

Table III. Effect of composted soil on numbers of nematodes (log) per 5 g roots and reduction (%) of *M. incognita* J_2 in the roots of Superior grapevines (2007 and 2008 seasons).

Compost		Initial nematode population (per 5 g roots) log x		Transformed values (log x) of numbers of nematodes and reduction (Red.) (%) of juveniles in roots in the first week of:											
				April				May				June			
				2007		2008		2007		2008		2007		2008	
Name	Rate (kg /grape-vine)	2007	2008	log x	Red. %	log x	Red. %	log x	Red. %	log x	Red. %	log x	Red. %	log x	Red %
El-Wady (EWC)	1.5	2.4	2.2	2.1 b	51 j	1.9 d	46 i	1.5 e	88 a	1.2 g	94 a	1.8 c	78 b	1.5 f	87 a
	3.0	2.0	2.0	1.8 c	36 l	1.6 f	59 g	1.1 g	89 a	1.7 d	65 f	1.5 e	73 c	2.0 c	29 i
	6.0	1.9	2.0	1.7 d	41 k	1.8 e	42 j	1.5 e	65 g	1.6 e	70 e	1.5 e	72 cd	1.7 e	68 b
El-Kattamiya (EKC)	1.5	1.4	1.9	1.2 h	54 i	1.5 g	52 h	1.1 g	45 h	1.7 d	54 i	1.5 e	27 j	1.7 e	42 f
	3.0	1.7	1.5	1.3 g	58 h	1.6 f	38 k	1.6 d	76 d	1.2 g	62 g	1.6 d	37 i	1.4 g	31 h
	6.0	2.2	2.1	1.7 d	76 e	1.3 i	82 c	2.3 a	76 c	1.7 d	69 e	1.9 b	64 g	1.8 d	56 d
Bio-green (BGC)	1.5	1.8	1.8	1.3 g	69 g	1.3 i	75 e	1.5 e	46 h	1.1 h	88 b	1.5 e	55 h	1.8 d	42 f
	3.0	2.1	1.9	1.6 e	73 f	1.2 j	83 c	1.7 c	70 f	1.8 c	48 j	1.3 g	89 a	1.8 d	40 g
	6.0	1.9	1.8	1.3 g	78 d	2.0 c	78 d	1.3 f	73 e	1.3 f	79 c	1.4 f	70 ef	1.5 f	59 c
Organic Complementary (OCC)	1.5	2.3	2.3	1.5 f	86 b	2.1 b	87 b	1.8 b	75 d	2.1 b	58 h	1.9 b	70 ef	2.2 b	40 g
	3.0	1.7	2.3	0.9 i	83 c	1.4 h	91 a	1.0 h	82 b	1.8 c	74 d	1.2 h	71 de	2.2 b	40 g
	6.0	1.7	1.6	0.7 j	91a	1.2 j	63 f	0.8 i	88 a	1.3 f	70 e	1.4 f	69 f	1.4 g	52 e
Control		2.3	2.3	2.3 a	-	2.3 a	-	2.3 a	-	2.5 a	-	2.4 a	-	2.4 a	-

Means in each column followed by the same letter are not significantly different according to LSD test (P = 0.05).

Table IV. Effect of composted soil on numbers and reduction (%) of galls of *M. incognita* per 5 g roots, in Superior grapevines (2007 and 2008 seasons).

Compost		Initial nematode galls/5 g roots (log x)		Transformed values (log x) of numbers of galls and reduction (Red.) (%) of numbers of galls in roots in the first week of:											
				April				May				June			
				2007		2008		2007		2008		2007		2008	
Name	Rate (kg /grape-vine)	2007	2008	log x	Red. %	log x	Red. %	log x	Red. %	log x	Red. %	log x	Red. %	log x	Red. %
El-Wady (EWC)	1.5	2.0	2.1	1.7 d	49 cd	2.0 b	38 fg	1.6 e	62 b	1.9 b	52 c	1.6 d	67 e	1.9 b	64 d
	3.0	2.0	1.9	1.7 d	50 bc	1.6 f	44 d	1.7 d	58 d	1.5 f	61a	1.5 e	78 a	1.5 e	78 a
	6.0	1.8	1.9	1.5 f	53 a	1.7 e	34 h	1.5 f	63 b	1.6 e	54 c	1.4 f	73 c	1.6 d	73 c
El-Kattamiya (EKC)	1.5	2.1	2.0	1.9 b	41 g	1.9 c	26 i	1.8 c	58 d	1.8 c	48 d	1.8 b	66 ef	1.7 c	62 de
	3.0	1.9	1.9	1.7 d	42 g	1.7 e	38 fg	1.6 e	58 d	1.7 d	54 c	1.5 e	67 e	1.6 d	58 f
	6.0	2.0	2.0	1.8 c	48 d	1.9 c	37 g	1.7 d	60 c	1.7 d	57 b	1.7 c	68 d	1.5 e	74 bc
Bio-green (BGC)	1.5	1.9	1.9	1.7 d	44 f	1.8 d	62 a	1.7 d	53 f	1.7 d	43 e	1.7 c	61 g	1.6 d	60 e
	3.0	1.8	1.9	1.6 e	51 bc	1.7 e	48 c	1.6 e	54 f	1.6 e	57 b	1.5 e	65 f	1.5 e	76 ab
	6.0	1.9	1.9	1.7 d	54 a	1.7 e	49 c	1.5 f	67 a	1.7 d	52 c	1.5 e	75 b	1.7 c	63 d
Organic Complementary (OCC)	1.5	2.2	2.2	2.1 a	42 g	2.0 b	41 e	1.9 b	62 b	1.9 b	54 c	1.8 b	74 bc	1.9 b	63 d
	3.0	1.9	1.9	1.7 d	49 cd	1.6 f	54 b	1.6 e	62 b	1.5 f	62 a	1.5 e	75 b	1.5 e	72 c
	6.0	1.9	1.9	1.6 e	46 e	1.7 e	43 de	1.5 f	57 e	1.6 e	57 b	1.5 e	67 e	1.6 d	63 d
Control		2.0	2.1	2.1 a	-	2.1 a	-	2.1 a	-	2.2 a	-	2.1 a	-	2.2 a	-

Means in each column followed by the same letter are not significantly different according to LSD test (P = 0.05).

ductions in the amended soil were in the ranges 41-89% and 29-94% with EWC, 27-78% and 31-82% with EKC, 46-89% and 42-88% with BGC, and 70-91% and 40-91% with OCC in the 2007 and 2008 seasons, respectively. The greatest percentage reduction in the roots occurred in the soil amended with EWC, followed by BGC, OCC and EKC.

All treatments were also highly effective in reducing root-knot galls of grapes. In the composted soil gall reductions ranged from 41 to 78% during the 2007 season and from 26 to 78% during 2008 (Table IV). More specifically, percentage reductions of galls in amended soil were in the ranges 49-78% and 34-78% with EWC, 41-68% and 26-74% with EKC, 44-75% and 43-76% with BGC, and 42-75% and 41-72% with OCC in the 2007 and 2008 seasons, respectively. The greatest reduction was achieved with OCC at all observation times. With this compost the reductions recorded with 1.5, 3.0 and 6.0 kg/grapevine were 74, 75 and 67% respectively, at the end of the first season and 63, 72 and 63% at the end of the second season. This was followed by EWC, BGC and EKC treatments, respectively (Table IV).

Effects of composted soil on *F. solani* and soil mycoflora

All the tested composts significantly decreased the frequency of occurrence (%) of the pathogenic fungus *F. solani* compared with the untreated rhizosphere soil, during the two seasons (Tables V and VI). This increase was greater the larger the rate of application. In 2007, OCC was more effective than EKC, BGC, and EWC in reducing the *F. solani* population in soil. *Fusarium solani* was not detected in amended rhizosphere with all rates of EKC (except 1.5 kg/grapevine), BGC and OCC at the end of season, and the fungus fequency percentages were in the range 6-7% in rhizosphere soil amended with all rates of EWC, compared with 33% in untreated soil (Table V). In 2008, EKC suppressed *F. solani* population in the soil more than soil amendment with OCC, BGC and EWC. *Fusarium solani* again was not detected in soil amended with all rates of the composts at the end of season, except in soil amended with OCC at 1.5 and 3.0 kg/grapevine, where the fungus frequencies were 11 and 3%, respectively (Table VI).

The effects of the tested composts on the frequency of occurrence of other species of the soil mycoflora are also in Tables V and VI. *Aspergillus* sp., *A. niger* Van Tieh, *A. terreus* Thom. *et* Church, *A. ochraceus* Wilhem, *Penicillium* sp., *P. chrysogenum* Thom., *P. citrinum* Thom., *P. corylophilum* Dirck, *Rhizopus nigricans* Stolonifer, *F. solani* and others were isolated from treated and untreated rhizosphere soil. *Aspergillus niger*, *A. terreus*, *P. chrysogenum*, *P. citrinum* and *P. corylophilum* were the predominant fungi (Tables V and VI). In soil amended with EWC in 2007, the highest frequency of occurrence was for *P. chrysogenum*, followed by *A. niger*, *A. terreus*, *P. citrinum* and *P. corylophilum* (Table V), while in 2008 *A. niger* was more frequent than *P. chrysogenum*, *A. terreus*, *P. citrinum* and *P. corylophilum* (Table VI). In EKC amended soil, *A. niger* had the highest frequency of occurrence, followed by *A. terreus*, *P. chrysogenum*, *P. corylophilum* and *P. citrinum*, respectively, during both seasons (Tables V and VI). When BGC was incorporated in the soil, *P. corylophilum* was more frequent than *A. niger*, *P. chrysogenum*, *A. terreus*, and *P. citrinum* in the first season (Table V), while in the second season *A. niger* was more common than *A. terreus, P. corylophilum, P. chrysogenum* and *P. citrinum* (Table VI). Application of OCC to the soil increased the frequency of occurrence of *A. niger*, *P. chrysogenum*, *A. terreus*, *P. corylophilum* and *P. citrinum* during both seasons (Tables V and VI).

Effects of composts on colonization of new grapevine roots by *F. solani*

All composts, even at low rates of application, suppressed colonization of new grapevine roots by *F. solani* as compared with untreated soil (Fig. 1). At harvest, the fungus frequency in new roots of treated grapevine was in the range 0-40% compared to 60-70% in untreated roots. BGC and OCC were more effective than EWC or EKC. A complete prevention of root colonization by *F. solani* was achieved when BGC and OCC were applied at the rates of 3 and 6 kg/grapevine and EWC at 6 kg/grapevine (Fig. 1). In 2007, the frequencies of *F. solani* in newly grown root pieces were 30, 40, 20 and 40% in soil amended with EWC, EKC, BGC and OCC, respectively, at the rate of 1.5 kg/grapevine, and zero in soil amended with all composts at 3 and 6 kg/grapevine, except for EKC for which the frequencies were 20 and 10%, respectively. In 2008, the new roots of grapevine had infection frequencies of *F. solani* of 40, 20, 10 and 30% in soil amended with all composts at 1.5 kg/grapevine and were free from *F. solani* in soil amended with 3 or 6 kg/grapevine, except for EWC at 3 kg/grapevine (20% frequency).

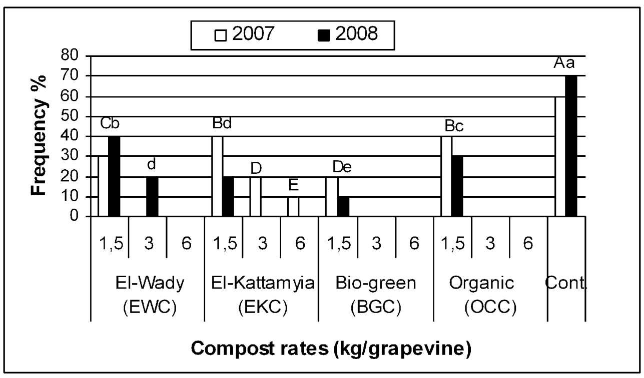

Fig. 1. Effect of composted soil on the frequency of occurrence (%) of *Fusarium solani* in new roots of Superior grapevines three months after field application. Means in each column followed by the same capital letter in 2007 and small letter in 2008 seasons are not significantly different according to LSD test (P = 0.05).

Table V. Effects of composted soil on the frequency of occurrence (%) of mycoflora in the rhizosphere of Superior grapevines for three months after field application (2007 season).

Fungus	Month	Frequency of occurrence (%) of fungi at different rates (kg/grapevine) of the tested composts												
		Control	El-Wady (EWC)			El-Kattamiya (EKC)			Bio-green (BGC)			Organic Complementary (OCC)		
			1.5	3.0	6.0	1.5	3.0	6.0	1.5	3.0	6.0	1.5	3.0	6.0
Aspergillus sp.	April	13e	17c	18b	10f	20a	14d	18b	18b	18b	8h	9g	17c	14d
	May	19d	16f	13g	11i	8k	9j	38a	12h	16f	27b	11i	23c	18e
	June	11f	20a	18b	18b	14d	8g	8g	14d	17c	18b	14d	13e	11f
A. niger	April	0	11c	9e	0	10d	7g	9e	8f	10d	4h	9e	38a	17b
	May	6h	16d	13f	6h	25b	27a	25b	12g	12g	12g	16d	15e	24c
	June	0	20a	18c	18c	20a	19b	20a	18c	17d	8f	9e	17d	17d
A. terreus	April	0	13b	9e	0	10d	11c	9e	14a	14a	10d	14a	9e	0
	May	0	0	0	0	0	0	0	12b	15a	8c	5e	8c	6d
	June	0	7f	6g	6g	7f	12c	4e	11d	17a	0	9e	14b	11d
A. ochraceous	April	13a	0	0	10b	0	0	0	0	0	0	0	0	0
	May	13a	11b	13a	11b	0	0	0	0	0	0	0	0	0
	June	0	7d	6e	12a	7d	8c	8c	11b	0	0	5f	0	0
Penicillium sp.	April	13d	3i	9f	10e	10e	18a	18a	14c	8g	17b	5h	0	14a
	May	13d	5g	13d	11f	0	0	14c	12e	13d	4h	11f	15b	18a
	June	0	0	6f	12c	0	8e	12c	14b	11d	12c	14b	17a	17a
P. chrysogenum	April	0	8g	9f	10e	0	11d	0	8g	8g	8g	21b	18c	37a
	May	0	5h	13d	11e	17b	18a	13d	6g	8f	8f	5h	15c	18a
	June	11e	13c	12d	12d	14b	0	0	7g	17a	13c	9f	13c	17a
P. citrinum	April	0	8c	6d	20a	10b	0	0	0	0	4e	4e	0	0
	May	0	0	13a	11b	0	0	0	0	0	0	11b	0	0
	June	0	0	6c	0	0	8b	8b	0	0	8b	9a	0	0
P. corylophilum	April	0	8e	9d	0	0	7f	9d	15b	9d	23a	11c	0	0
	May	0	0	0	0	17b	0	0	18a	11e	12d	16c	0	0
	June	11c	0	0	0	7e	8d	8d	7e	6f	17a	14b	0	0
Rhizopus nigricans	April	13a	0	0	10b	10b	7d	9c	3f	0	7d	4e	0	0
	May	6g	16c	0	11d	8f	18b	0	6g	9e	19a	5h	0	0
	June	11c	7e	6f	6f	7e	12b	8d	7e	0	0	5g	13a	11c
Fusarium solani	April	38a	18b	15c	10d	10d	7g	9e	6h	8f	2j	5i	0	0
	May	28a	11c	13b	6e	8d	0	0	6e	5f	0	5f	0	0
	June	33a	7b	6c	6c	7b	0	0	0	0	0	0	0	0
Others	April	10g	14f	16e	20a	20a	18c	19b	14f	19b	17d	18c	18c	18c
	May	5k	20d	9j	22c	17e	28a	10i	16f	11h	10i	15g	24b	16f
	June	23b	19c	16e	10j	17d	17d	24a	11i	15f	24a	12h	13g	16e

Means in each row followed by the same letter are not significantly different according to LSD test (P = 0.05).

Effects on some vegetative growth variables

A significant increase (Table VII) in leaf area was observed with all composts, except EWC. However, in the first season leaf area increases occurred only at some rates, while in the second season, except for BGC at 6 kg/grapevine, significant increases were observed at all application rates. The largest leaf area increase was achieved with OCC followed by EKC and BGC.

The greatest cane thickness (Table VII) occurred in grapevines treated with OCC, even at the lowest dose, followed by EKC, BGC and EWC.

Table VI. Effects of composted soil on the frequency of occurrence (%) of mycoflora in the rhizosphere of Superior grapevines for three months after field application (2008 season).

Fungus	Month	Frequency occurrence % of fungi at different rates (kg/grapevine) of the tested composts												
		Control	El-Wady (EWC)			El-Kattamiya (EKC)			Bio-green (BGC)			Organic Complementary (OCC)		
			1.5	3.0	6.0	1.5	3.0	6.0	1.5	3.0	6.0	1.5	3.0	6.0
Aspergillus sp.	April	14e	23a	21b	8h	14e	7i	14e	15d	17c	6j	6j	9g	11f
	May	18c	11i	12h	13g	15e	9j	31a	17d	14f	18c	26b	13g	7k
	June	12f	15d	9g	17b	14e	7h	6i	16c	21a	21a	14e	14e	14e
A. niger	April	0	12c	12c	15a	14b	14b	9f	5h	10e	10e	6g	6g	11d
	May	0	17g	22d	19e	23c	27a	19e	17g	23c	18f	16h	13j	25b
	June	0	23e	27a	25c	21f	24d	19g	26b	21f	14h	12j	13i	14h
A. terreus	April	0	14b	9e	8g	7f	11c	9e	11c	10d	10d	17a	5h	0
	May	0	0	11b	6f	0	0	10c	17a	9d	9d	5g	6f	7e
	June	0	8g	9f	8g	7h	12e	13d	16b	7h	14c	12e	17a	14c
A. ochraceous	April	14a	0	0	8b	0	0	0	0	0	0	0	0	0
	May	0	11a	0	0	0	0	0	0	0	0	0	0	0
	June	0	8a	0	0	0	0	0	0	0	0	0	0	0
Penicillium sp.	April	14d	5i	6h	0	7g	14d	20a	14d	10f	16c	20a	18b	11e
	May	6h	11d	11d	6h	15a	9f	10e	8g	14b	9f	11d	13c	13c
	June	20a	8h	9g	17b	7i	12e	13d	11f	7i	14c	12e	13d	14c
P. chrysogenum	April	0	5h	9e	8f	0	14c	0	8f	10d	8f	7g	19b	33a
	May	0	11f	22a	14d	8h	18c	10g	0	0	5i	11f	13e	20b
	June	0	8c	18a	0	7d	0	0	0	0	0	6e	7d	14b
P. citrinum	April	0	9c	6e	8d	14a	0	0	0	0	4g	6e	5f	11b
	May	0	0	0	13b	0	0	10c	17a	0	0	5f	6e	7d
	June	0	8e	9d	0	7f	6g	19a	5h	14b	7f	12c	0	0
P. corylophilum	April	0	5j	6i	8g	7h	11e	11e	17b	17b	20a	9f	16d	11e
	May	0	0	0	0	15b	9e	0	0	14c	14c	16a	13d	7f
	June	0	0	0	0	14a	6f	13b	11c	7e	7e	6e	8d	0
Rhizopus nigricans	April	14a	2g	0	8c	14a	7d	9b	5f	0	6e	6e	5f	0
	May	12d	17b	0	13c	0	18a	0	0	9e	18a	5h	6g	7f
	June	4j	15d	0	17c	2k	18b	6h	5i	7g	7g	6h	13f	14e
Fusarium solani	April	29a	9c	12b	8d	7e	7e	9c	6f	7e	2g	6f	0	0
	May	44a	6f	13c	0	8e	0	0	17b	9d	0	0	0	0
	June	40a	0	0	0	0	0	0	0	0	0	11b	3c	0
Others	April	15f	16e	19b	21a	16e	15f	19b	19b	19b	18c	17d	17d	12g
	May	20a	16c	9e	16c	16c	10d	10d	7g	8f	9e	5h	17b	7g
	June	24a	7j	19c	16d	21b	15d	11g	10h	16d	16d	9i	12f	16d

Means in each row followed by the same letter are not significantly different according to LSD test (P = 0.05).

Effect on leaf mineral content

Macro-elements. Nitrogen (N) content in the leaves (Table VII) was significantly affected by all treatments in both seasons. However, OCC resulted in the highest N content of leaves, followed by BGC, EKC and EWC. There was a gradual increase of N with the increasing rates of the composts in both seasons. Phosphorus (P) content was not significantly increased by any of the treatments (Table VII), while Potassium (K) increased only slightly in both growth seasons (Table VII).

Table VII. Effect of different composts on vegetative growth characteristics and leaf mineral content of Superior grapevine grown in soil infested with *M. incognita* and *F. solani* (2007 and 2008).

Compost		Vegetative growth				Leaf mineral content											
						Macro-elements (%)						Micro-elements (ppm)					
Name	Rate (kg /grape-vine)	Leaf area (cm^2)		Cane thickness (cm)		Nitrogen (N)		Phosphorous (P)		Potassium (K)		Iron (Fe)		Manganese (Mn)		Zinc (Zn)	
		2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008
El-Wady (EWC)	1.5	124.4 de	126.7 d	2.4 b	2.4 b	2.1 g	2.5 e	0.2 a	0.3 a	1.5 c	1.7 c	97.0m	174.5 f	80.5 i	87.0 i	27.0 a	29.5 a
	3.0	119.8 e	132.0 d	2.2 d	2.3 c	2.2 f	2.4 f	0.3 a	0.3 a	1.6 b	1.6 d	122.5i	124.0 m	86.5 k	96.5 j	33.5 a	50.0 a
	6.0	130.7 de	137.5 cd	2.2 d	2.4 b	2.3 e	2.7 d	0.3 a	0.3 a	1.4 d	1.5 e	146.5e	211.0 c	123.0a	137.0 d	32.5 a	51.0 a
El-Kattamyia (EKC)	1.5	126.2 de	157.0 c	2.3 c	2.5 a	2.4 d	2.8 c	0.2 a	0.2 a	1.4 d	1.5 e	133.5g	181.5 e	89.5 g	92.5 k	30.5 a	37.0 a
	3.0	162.2 ab	164.3 bc	2.4 b	2.5 a	2.5 c	2.5 e	0.2 a	0.3 a	1.6 b	1.9 b	174.0c	221.5 b	109.5c	141.5 c	30.0 a	46.0 a
	6.0	136.1 cd	164.9 abc	2.2 d	2.3 c	2.7 a	2.8 c	0.3 a	0.3 a	1.3 e	2.1 a	108.5k	169.0 g	84.0 i	118.5 e	28.5 a	40.0a
Bio-green (BGC)	1.5	124.7 de	146.9 c	2.3 c	2.3 c	2.5 c	2.7 d	0.2 a	0.3 a	1.4 d	1.6 d	236.0a	238.5 a	86.0 j	104.5 i	37.5 a	40.0 a
	3.0	134.0 cd	150.7 c	2.4 b	2.4 b	2.7 a	2.8 c	0.3 a	0.3 a	1.4 d	1.4 f	143.5f	145.5 k	83.0 k	86.0 m	30.0 a	32.5 a
	6.0	147.9 c	121.4 e	2.3 c	2.3 c	2.6 b	2.8 c	0.3 a	0.3 a	1.4 d	1.7 c	205.0b	206.0 d	111.5 b	161.5 b	32.0a	38.5 a
Organic Complementary (OCC)	1.5	171.6 a	171.5 ab	2.5 a	2.5 a	2.7 a	2.9 b	0.2 a	0.3 a	1.6 b	1.6 d	99.5 l	162.5 h	91.0 f	108.5 f	33.0 a	37.0 a
	3.0	167.4 ab	178.7 a	2.3 c	2.4 b	2.5 c	3.0 a	0.3 a	0.3 a	1.3 e	1.7 c	130.5h	156.0 i	83.0 k	107.5 h	31.5 a	44.5 a
	6.0	153.4 b	171.8 ab	2.4 b	2.4 b	2.4 d	2.7 d	0.2 a	0.3 a	1.7 a	1.7 c	147.5d	147.5 j	102.0e	108.0 g	31.5 a	33.5 a
Control		130.5 de	129.7 d	2.2 d	2.2 d	1.7 h	2.2 g	0.2 a	0.3 a	1.4 d	1.4 d	114.0 e	128.0 i	102.5 d	214.0 a	35.0 a	42.5 a

Means in each column sharing a common letter are not significantly different according to LSD test (P = 0.05).

Micro-elements. The greatest increase in Fe content (Table VII) was given by BGC followed by EKC, OCC and EWC. None of the composts increased Mn content of the leaves, and only a small increase was observed with Zn.

Effect on physical characteristics

Cluster. All compost treatments significantly increased the total weights of the clusters (Table VIII), which in the treated vines ranged from 389.4 to 667.7 g and from 481.6 to 693.2 g during the 2007 and 2008 seasons, respectively, compared with 366.8 and 355.8 g for the untreated vines, respectively. The maximum cluster weight was obtained with OCC at 3 kg/grapevine (667.7 g) in 2007 and with EWC at the same rate (693.2 g) in 2008.

The compost treatments increased the total weight of berries/cluster compared with the untreated control. Total weight of berries/cluster ranged from 379.7 to 650.5 g during the 2007 season and from 464.2 to 672.0 g during 2008, compared with 358.6 and 344.1 g in the untreated control, respectively (Table VIII). The maximum weight of berries/cluster was achieved with OCC (650.5 g) and EKC (672.0 g) at 3 kg/grapevine in 2007 and 2008, respectively.

In general, in the amended soils, the weight of the rachis increased significantly. It ranged from 9.5 to 17.2 g and from 12.2 to 21.2 g in the 2007 and 2008 seasons, respectively, compared with 8.2 and 11.7 g in the untreated control, respectively (Table VIII). The greatest rachis weight was given by OCC (12.1-17.2 g) in 2007 and by EKC (13.9-21.2 g) in 2008.

All tested composts improved the cluster compactness of Superior grapes in both seasons (Fig. 2), with the greatest cluster compactness given by EWC at the lowest dose in both seasons (12.6 and 13.8), compared with the untreated control (5.5 and 6.6).

Berry. The weight of the berries was significantly affected by some compost treatments and ranged from 2.4 to 3.6 g and from 2.7 to 3.8 g compared with 2.5 and 2.6 g in the untreated control during the 2007 and 2008 seasons, respectively (Table VIII). More specifically, it was in the ranges 2.4-3.4 g with EWC, 2.5-3.1 g with EKC, 2.7-4.0 g with BGC, and 2.6-3.8 g with OCC. The best performance was given by BGC at all rates, while OCC, EWC and EKC increased berry weight only at some rates.

Excepted with EWC, the length of berries in the compost treatments was increased significantly and was in the ranges 1.4 to 2.2 cm and 2.0 to 2.5 cm compared with 1.8 and 2.0 cm in the untreated control, in the 2007 and 2008 seasons, respectively (Table VIII).

The diameter of berries was also significantly increased in the amended soils and ranged from 1.5-2.0 cm with EWC, 1.4-1.9 cm with EKC, 1.8-2.1 cm with BGC, and 1.8-2.0 cm with OCC, compared with 1.5 and 1.7 in the control, in 2007 and 2008, respectively (Table VIII).

None of the composts significantly affected berry shape (L/D) of Superior grapes in either season (Fig. 3).

Effect on chemical characteristics of the fruits

The amended soils significantly increased TSS% in grape berries in both seasons (Table IX), and it ranged from 14.7 to 16.5% and from 14.9 to 17.0% in 2007 and 2008, compared with 14.0 and 14.5% in the untreated control, respectively. Soil amended with EWC had TSS in the range from 14.7-17.0%, while it was from 14.9 to 16.4%, from 14.7 to 16.1% and from 15.4 to 15.9% with EKC, BGC and OCC, respectively. The greatest TSS percentages were obtained in soil amended with EWC (16.5 and 17.0%), followed by soil amended with EKC (16.0 and 16.4%) at the intermediate dose in 2007 and 2008, respectively.

During the two growing seasons, the TA percentage in grape berries ranged from 0.34 to 0.54% in soil amended with the composts and from 0.45 to 0.47% in berries from the control (Table IX) and no significant differences occurred among treatments.

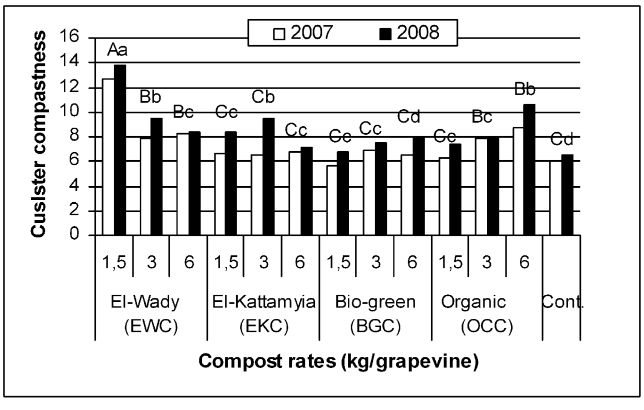

Fig. 2. Effects of amended soil on the cluster compactness in Superior grapevines. Means in each column followed by the same capital letter in 2007 and small letter in 2008 seasons are not significantly different according to LSD test (P = 0.05).

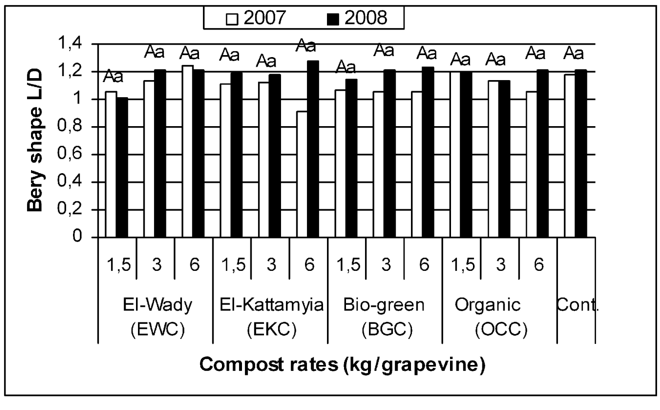

Fig. 3. Effect of organic amended soil on the berry shape (L/D) of Superior grapevines. Means in each column followed by the same capital letter in 2007 and small letter in 2008 seasons are not significantly different according to LSD test (P = 0.05).

Table VIII. Effect of different composts on physical characteristics of Superior grapevine clusters and berries grown in soil infested with *M. incognita* and *F. solani* (2007 and 2008).

Compost		Cluster weight (g)		Berries/cluster weight (g)		Rachis weight (g)		Berry weight (g)		Berry length (cm)		Berry diameter (cm)	
Name	Rate (kg /grapevine)	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008
El-Wady (EWC)	1.5	649.6 ab	561.4 cd	633.5 ab	542.8 bc	16.1 ab	18.6 abd	3.1 b	3.4 bc	1.8 e	2.0 f	1.7 d	2.0 b
	3.0	489.9 de	552.6 cd	478.7 d	540.7 bc	11.2 def	12.2 f	2.4 c	3.4 bc	1.8 e	2.1 e	1.6 e	1.8 d
	6.0	538.2 cde	483.3 d	526.0 cd	464.2 c	12.2 cd	19.1 ab	2.6 c	2.8 e	1.7 f	2.0 f	1.5 f	1.7 e
El-Kattamyia (EKC)	1.5	592.6 abc	497.2 d	577.8 abc	480.4 c	14.8 abc	16.8 bcd	2.5 c	3.1 bcd	1.8 e	2.0 f	1.7 d	1.4 f
	3.0	470.3 e	693.2 a	459.7 de	672.0 a	10.6 def	21.2 a	2.6 c	3.1 bcd	2.0 c	2.2 d	1.8 c	1.9 c
	6.0	587.8 abc	493.3 d	574.4 abc	479.4 c	13.4 bcd	13.9 ef	3.1 b	3.1 bcd	1.6 g	2.4 b	1.8 c	1.9 c
Bio-green (BGC)	1.5	565.6 cd	606.7 bc	554.6 bcd	590.5 ab	11.0 def	16.2 bcde	3.4 ab	3.5 b	1.4 h	2.2 d	1.9 b	1.9 c
	3.0	579.8 bc	481.6 d	568.4 abc	465.7 c	11.4 def	15.9 cde	3.5 a	2.7 e	1.9 d	2.2 d	1.8 c	1.9 c
	6.0	389.4 f	670.5 ab	379.7 e	655.9 a	9.5 ef	14.6 def	3.0 b	4.0 a	2.1 b	2.5 a	2.0 a	2.1 a
Organic Complementary (OCC)	1.5	429.9 ef	516.9 d	417.6 e	504.6 c	12.1 cdef	12.3 f	3.0 b	3.2 bc	2.2 a	2.4 b	1.8 c	2.0 b
	3.0	667.7 a	644.5 ab	650.5 a	627.3 a	17.2 a	17.2 bcd	3.6 a	3.8 ab	2.1 b	2.3 c	1.8 c	2.0 b
	6.0	580.0 bc	517.7 d	564.3 bc	500.8 c	15.9 ab	16.9 bcd	2.6 c	2.6 e	1.9 d	2.3 c	1.8 c	1.9 c
Control		366.8 f	355.8 e	358.6 e	344.1 d	8.2 f	11.7 f	2.5 c	2.6 e	1.8 e	2.0 f	1.5 f	1.7 e

Means in each column sharing a common letter are not significantly different according to LSD test (P = 0.05).

The treatments increased significantly the TSS/TA ratio in grape berries, in which it ranged from 21.3 to 47.7% and from 34.3 to 51.3% compared with 32.5 and 31.3% in fruits of the control grapevine in the 2007 and 2008 seasons, respectively. The most significant differences occurred in 2008, with maximum values of TSS/TA of 47.7% with BGC in 2007 and of 51.3% with EKC in 2008, at the largest rate of application (Table IX).

Effect on grape yield

Yield of grapes (Fig. 4) was also affected significantly by the compost treatments and ranged from 10 to 16.7 kg and from 9.9 to 20.9 kg/grapevine in the 2007 and 2008 seasons, compared with 8.4 kg and 10.2 kg/grapevine in the control, respectively. For the different treatments, it ranged from 11.9 to 17.0 kg in EWC amended soil, from 10.1 to 16.4 kg with EKC, from 10 kg to 16.9 kg with BGC and from 9.9 to 20.9 kg with OCC. OCC at the intermediate dose gave the largest yield/grapevine in both growing seasons and significantly increased the yield by 98.8 and 104.9% in 2007 and 2008, respectively, followed by EWC (lowest dose),

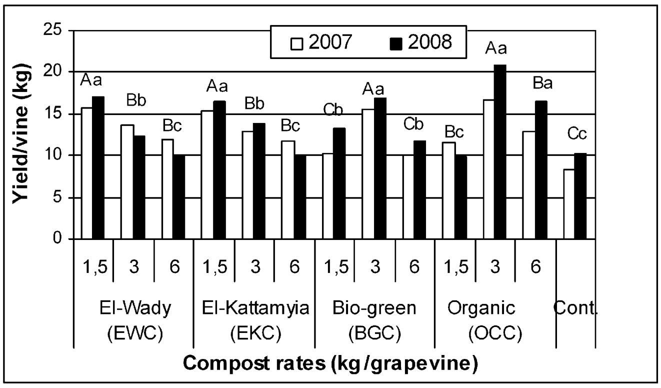

Fig. 4. Effect of organic amended soil on the yield/vine (kg) of Superior grapevines. Means in each column followed by the same capital letter in 2007 and small letter in 2008 seasons are not significantly different according to LSD test (P = 0.05).

BGC (intermediate dose) and EKC (lowest dose) in the first season. In 2008, the EWC-amended soil (low dose) increased the yield by 66.7 %, followed by BGC at the intermediate dose and EKC at the smallest dose, with increases of 65.7 and 60.8 %, respectively.

Table IX. Effects of amended soils on some chemical characteristics of Superior grape berries (2007 and 2008).

Compost		% chemical characteristics					
Name	Rate (kg/grapevine)	Total soluble solids (TSS)		Total acidity (TA)		TSS/TA ratio	
		2007	2008	2007	2008	2007	2008
El-Wady (EWC)	1.5	15.0 cd	16.3 ab	0.54 a	0.43 a	28.3 a	41.9 bc
	3.0	16.5 a	17.0 a	0.45 a	0.40 a	38.9 cd	45.7 ab
	6.0	14.7 de	15.9 bc	0.38 a	0.34 a	39.0 bcd	48.4 a
El-Kattamyia (EKC)	1.5	15.0 cd	15.3 cde	0.40 a	0.40 a	40.2 bc	40.6 bcd
	3.0	16.0 ab	16.4 ab	0.45 a	0.47 a	21.3 E	39.3 bcd
	6.0	14.9 cd	15.3 cde	0.34 a	0.34 a	45.4 ab	51.3 a
Bio-green (BGC)	1.5	15.0 cd	15.1 cde	0.47 a	0.34 a	33.3 de	46.1 ab
	3.0	14.7 de	14.9 cde	0.38 a	0.40 a	40.9 abc	37.7 cd
	6.0	15.3 bcd	16.1 b	0.38 a	043 a	47.7 a	41.2 bc
Organic Complementary (OCC)	1.5	15.4 bcd	15.9 bc	0.54 a	0.38 a	29.0 e	45.2 ab
	3.0	15.4 bcd	15.5 bcd	0.40 a	0.36 a	42.7 ab	45.2 ab
	6.0	15.7 abc	15.9 bc	0.45 a	0.47 a	36.3 cde	34.3 d
Control		14.0 e	14.5 e	0.45 a	0.47 a	32.5 de	31.3 e

Means in each column sharing a common letter are not significant differaccording to LSD test (P = 0.05).

DISCUSSION

The four tested composts were promising in suppressing root-knot and root-rot diseases on grapevine cv. Superior and increasing soil mycoflora and crop yield. The suppressive effects of the four composts occurred throughout the observation period. The suppressive effects may be due to soil mycoflora that are able to survive in the composts and to greater microbial activity, resulting in the secretion of various simple and complex compounds, which in turn prevent germination of spores of soil-borne plant pathogens and infection of the host (Chavarria and Rodriguez, 1998; Bailey and Lazarovits, 2003). Several investigators (Manici *et al.*, 2004; Steinberg *et al.*, 2004; Krishnakumar *et al.*, 2005) attributed the suppressive effects of composts to the different organic N sources and their decomposition, which increased the population of saprophytic micro-organisms, of which some acted as antagonists to plant pathogens. In our investigation, the predominant soil mycoflora isolated from grapevine soil amended with composts were *A. niger*, *A. terreus*, *P. chrysogenum*, and *P. corylophilum*. These results agree with those reported by Manta and Sharma (2002) who found that the most predominant fungi isolated from the amended soil were *Aspergillus* spp. and *Penicillium* spp. These fungi were reported to have the greatest inhibition effects on *F. solani* growth in a dual culture experiment by Ambikapathy *et al.* (2002).

The performance of the tested composts against the root knot nematode was conspicuous as it resulted in significant reductions of numbers of *M. incognita* J_2 in the soil and root galling. According to previous studies (McSorely and Gallaher, 1997; Oka and Yermujaha, 2002; Kimpinski *et al.*, 2003; Nico *et al.*, 2004), there appear to be more than one mechanism of nematode suppression when composts are applied. The accumulation of certain nitrogenous compounds produced during organic matter decomposition is toxic to nematodes. Stirling (1991) believed that nematicidal activity from nitrogenous by-products was most evident when the carbon : nitrogen (C:N) ratio was less than 20:1, which is believed to be the case in the present study. Moreover, Widmer *et al.* (2002) reported that incorporation into the soil of organic materials provides soil organisms with a new energy source, thus resulting in increased diversity and activity of naturally occurring soil microbes that are antagonistic to nematodes.

However, the amendment with composts also probably improved grapevine performance and yield by increasing soil organic matter content and water holding capacity of the soil, which, in turn, positively affected growth variables (leaf area), leaf mineral content (nitrogen, potassium, iron and manganese) and yield components such as physical characters (berry weight, berry number, cluster weight and compactness) and chemical characters (TSS%), but not berry shape. Our findings agree with Fujiwara (1996) and Jonathan *et al.* (2000) who found that compost application and mulching stimulated root growth, improved fruit colour and increased weight and sugar content of grape fruits. Also, Kassem and Marzouk (2002) reported that organic fertilization increased nutrient levels and productivity as well as fruit quality of grapevine.

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