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Effect of Different Compost Sorts and Biofertilizers on Chemlali Olive Trees Grown in Calcareous Soil

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Abstract: Olive trees (Chemlali Cv.) grown in calcareous soil were supplied with aqueous extract of three compost sorts *i.e*. farmyard manure, town refuse and sewage sludge at two rates (20% and 30% by volume), either alone or combined with bacterial suspension of *Azotobacter chroococcum*. Results showed pronounced beneficial effects of different tested composts at rate 30% that reflected on vegetative growth, yield and flesh oil content. The best results were obtained with sewage sludge treatment followed in descending order by town refuse and farmyard manure, as compared with control. Incorporation of bacterial suspension of *Azotobacter chroococcum* with aqueous extract of any tested composts produced synergistic beneficial effects as used with either 20% or 30% concentration.

Key words: Composts · Biofertilizers · Olive · Calcareous soil · *Azotobacter chroococcum*

INTRODUCTION

Relatively low water requirement of olive trees and its successful productivity in calcareous soils create rapidly increasing of its cultivation areas in Egypt in last few years. Scars of organic matter in highly calcareous soils as Burg El-Arab region considered one of the limiting factors for horizontal agricultural expansion in this region. In the same time, organic wastes increasing progressively exerting environmental problem in Egypt. On the other hand, excessive chemical fertilizers bring about severe contamination to either soil or tree. Also, mentioned fertilizer wash out and collected in ground water and rivers causing distribution in fundamental biological balance. Meanwhile, composts have favourable effects on plant growth through improving chemical and physicochemical soil properties [1], improving water deficiency [2] and providing soil with essential macro and micronutrients [3].

Recently, biofertilizers have been developed to enhance nutrient uptake and satisfy requirements of several composts for fruit trees. Hence, several beneficial micro-organisms can be effectively used as alternative to chemical fertilizers to minimize the environmental pollution. N_2-fixing bacteria like *Azotobacter sp*. have been developed in several laboratories in Egypt [4]. Now a days, clean agriculture has received more attentions by application of different compost sorts and biofertilizers to minimize environmental problems as well as improving structure and fertility in calcareous soil where fruit orchards [5]. Therefore, this study was designed to study the response of vegetative growth, yield and fruit oil content in Chemlali olive trees as planted in calcareous soil and amended with three compost sorts either alone or combined with *Azotobacter chroococcum* as biofertilizer responsible for increasing availability of compost nutrients.

MATERIALS AND METHODS

This study was conducted in Burg El-Arab region (54 km west of Alexandria), Egypt on olive trees, Chemlali Cv. Seventy eight trees uniform in size and vigor in growth were selected in August 2010 to receive treatments. Aqueous extract of three compost sorts *i.e*. Farmyard Manure (FM), Town Refuse (TR) and Sewage Sludge (S.SL) were prepared. Physico-chemical characteristics of studied soil site and organic manures applied are presented in Tables 1 and 2, respectively.

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Table 1: Soil physico- chemical characteristics

Characters	Values
pH	8.80
Total N %	220.0
Total P %	11.0
Total Zn (ppm)	45.0
Total Mn (ppm)	65.0
Total Fe (ppm)	300.0
O.M %	0.18
$CaCO_3$ %	21.50
Soil texture	Loamy sand

Table 2: Compost used characteristics

Characters	Farmyard manure (FM)	Town refuse (TR)	Sewage sludge (S. SL)
EC dS/m (1:20)	1.20	5.20	2.10
pH (1:10)	7.80	6.80	7.10
O.M %	29.70	44.20	49.30
Moisture content %	29.50	14.70	7.0
Bulk density (g/cm^3)		0.45	0.51
Soluble macronutrients %			
N	830.0	225.0	1070.0
P	214.0	41.0	7.0
K	575.0	115.0	40.0
Mg	52.0	44.0	39.0
Ca	206.0	93.0	360.0
Extractable micronutrients* (ppm)			
Zn	45.0	195.0	304.0
Mn	47.0	84.0	52.0
Fe	318.0	575.0	525.0
Cu	1.0	60.0	38.0

Aqueous extract of tested composts was added 3 times at first of (October, November and January) with irrigation system at 20% and 30% by volume. As for biofertilizer treatment, soil was inoculated in October with 15ml of bacterial suspension of *Azotobacter chroococcum* (B) as nitrogen fixer strain (at 0.5 meter around canopy). Irrigation was regulatory carried out at intervals according to weather conditions. Treatments were applied as follows:

- Control (received normal treatments of orchard)
- Extract of FYM (20%)
- Extract of FYM (30%)
- Extract of TR (20%)
- Extract of TR (30%)
- Extract of S.SL (20%)
- Extract of S.SL (30%)
- Extract of FYM (20%) + biofertilizer (B)
- Extract of FYM (30%) + biofertilizer (B)
- Extract of TR (20%) + biofertilizer (B)
- Extract of TR (30%) + biofertilizer (B)
- Extract of S.SL (20%) + biofertilizer (B)
- Extract of S.SL (30%) + biofertilizer (B)

Fruit yield of trees received treatments determined in October and flesh fruit oil content was estimated according to method described buy A.O.A.C [6]. Experiment was designed as randomized complete block design with 3 replicates (2 trees/replicate).

Statistical Analysis: Data subjected to analysis of variance to determine the significant differences and Duncan's multiple range test [7] was used for means comparison when F test significant at $P \geq 0.05$.

RESULTS AND DISCUSSION

The results presented in Table 3 illustrated the effect of different sorts of compost alone or in combination with *Azotobacter chroococcum* (B) on shoot length and number of leaves/shoot of Chemlali olive trees. The obtained data revealed that adding extract of different tested composts reflected significant increases in both shoot length and number of leaves/shoot as compared with control. Using FYM at 30% gave higher values in shoot length (12.65cm) and reached (13.15cm) as combined with *Azotobacter*

Table 3: Effect of different sorts of compost and biofertilizer on shoot length and leaf/shoot numbers of Chemlali olive trees planted in calcareous soil (average of two seasons)

	Shoot length (cm)			Number of leaves/ shoot		
	Sorts of compost			Sorts of compost		
Concentration (v/v) %	FYM	TR	S.SL	FYM	TR	S.SL
Control	11.45^{b}	11.45^{b}	11.45^{c}	7.25^{b}	7.25^{b}	7.25^{b}
20	12.50^{ab}	13.85^{a}	15.05^{b}	8.65^{b}	9.90^{a}	10.85^{a}
30	12.65^{ab}	14.35^{a}	15.70^{ab}	9.85^{ab}	10.50^{a}	11.10^{a}
20 + B	12.75^{ab}	14.80^{a}	16.15^{ab}	10.15^{a}	10.50^{a}	11.35^{a}
30 + B	13.15^{a}	15.20^{a}	16.95^{a}	10.80^{a}	10.90^{a}	11.50^{a}
Mean	12.76	14.55	15.96	9.86	10.45	11.20

Means of each compost followed by same letter(s) are not significantly different compared with control at 5% level.

Table 4: Effect of different sorts of compost and biofertilizer on yield and flesh oil content of Chemlali olive trees planted in calcareous soil (average of two seasons)

	Tree yield (kg)			Flesh oil content (% on dry wt. basis)		
	Sorts of compost			Sorts of compost		
Concentration (v/v) %	FYM	TR	S.SL	FYM	TR	S.SL
Control	25.00^{d}	25.00^{d}	25.00^{d}	22.85^{e}	22.85^{d}	22.85^{c}
20	27.30^{c}	28.00^{c}	30.20^{c}	26.10^{c}	30.10^{c}	33.00^{b}
30	28.90^{b}	30.00^{b}	33.00^{b}	28.00^{b}	32.40^{b}	33.50^{b}
20 + B	30.20^{ab}	34.20^{a}	36.60^{a}	29.85^{ab}	32.80^{b}	34.40^{ab}
30 + B	32.20^{a}	35.20^{a}	37.50^{a}	30.75^{a}	34.30^{a}	35.00^{a}
Mean	29.65	31.85	34.33	28.68	32.40	33.98

Means of each compost followed by same letter(s) are not significantly different compared with control at 5% level.

chroococcum. Moreover, the highest leaves number /shoot (10.80) were obtained with FYM at 30% +B followed in a descending order by FYM at 20% + B (10.15) with non significant differences. Adding TR compost at different rates either alone or in combinations with B gave higher values than control for both shoot length and number of leaves/shoot with non significant differences between treatments. While, different S.SL applications positively increased number of leaves/shoot, where shoot length was significantly higher as S.SL at 30% + bacteria used.

Based on mean values, the increments in shoot lengths were 11%, 27% and 39% where, number of leaves/shoot was 36%, 44% and 54% over control for FYM, TR and S.SL, respectively. Improving plant growth resulted by composts applications may be due to increases in growth of root system that exert more absorption of water and nutrients. The abovementioned tables cleared that incorporation of bacterial suspension of *Azotobacter chroococcum* as biofertilizer with aqueous extract of composts had a synergistic effect with all composts used. This may be due to that inoculation of bacteria resulted in positive biomass production through direct effect on root growth, production of phytohormones and mineral enhancement uptake and transfer of several vital nutrients such as N, P and K from soil to plant [8, 9]. Besides, production of bio-control agents against soil-borne phyto-pathogens play indirect role in this respect [10]. Results concerning the effect of compost sorts on yield and flesh oil content as presented in Tables 4 cleared the positive correlation between both yield fruit production and flesh oil content as compared with control. Different compost treatments reflected higher values for either yield (28.9, 30.0 and 33.0 kg/tree) or flesh oil content (28.0, 32.4 and 33.5%) as FYM, TR and S.SL were sole used at 30%, respectively. Inoculation tested composts at rate 30% with *Azotobacter chroococcum* bacteria increased above-mentioned values to reach average of tree yield (32.2, 35.2 and 37.5kg) and flesh oil content (30.75, 34.3 and 35.0%) for FYM, TR and S.SL treatments, respectively. Similar results were also significantly recorded as TR or S.SL was used at 20% in combination with bacteria.

Therefore, an improvement of yield and flesh oil content was superiority obtained with sewage sludge compost followed by town refuse and farmyard manure. With all composts, treatments received biofertilizer combined with compost resulted better yield and flesh oil

content compared with those received compost alone [11-13]. Enhancing effects of both composts and biofertilizer on production of Citokinins, proteins, nucleic acids, vitamin B, auxins and nitrogen fixation reflected on increments of photo-synthesis in trees [14]. Higher carbohydrates considered a main factor responsible for increment of yield and flesh oil content obtained.

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