Effect on Harvest of Olive Trees Fertilized with Sewage Sludge Compost

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Abstract

The soil of the Mediterranean regions is impoverishing. The need of organic matter to maintain soil productivity and to fight erosion and desertization has led to the search for new material as a complement or a substitute of the traditional ones, such as harvest wastes, animal manures or peats. Organic waste produced by society contains the fundamental nutrients plants which could incorporate to soil and use in agriculture, such us to olive grove soil. In order to evaluate the agricultural use of sewage sludge compost (SSC) it has been studied the effect of SSC on three parameters of olive fruit (humidity, fat and heavy metal content). Results indicate that olives which were fertilized with SSC and SSC + Urea presented more humidity content that fertilized with urea. Heavy metals from SSC do not affect to heavy metal content in olive fruit.

INTRODUCTION

The olive, which originated in the Mediterranean basin, is one of the oldest agricultural tree crops. The fruit, the olives contain about 50% water, 20 to 25% oil, 25% carbohydrates, and small proportions of proteins. Olives are free of antinutritional or toxic substances and can be eaten marinated. It is a delicate fruit than cannot be stored for a long time.

The soil of the Mediterranean regions is impoverishing. The main reasons are soil erodibility; desertification caused by erosion through water and wind, salinization and alcalinization; low content in organic matter and so low fertility; soil contamination. (Winfried, 2001).

This increasing need of organic matter to maintain soil productivity and to fight erosion and desertization has led to the search for new material as a complement or a substitute of the traditional ones, such as harvest wastes, animal manures or peats (Hernando, 1989). Organic waste produced by society contains the fundamental nutrients plants (Nilsson, 2001) which could incorporate to soil and use in agriculture once it has been treated with a necessary compost process.

One of the agricultural use of compost is to apply it to olive grove soil. Different studies have shown that applications of nitrogen fertilizers to olive trees definitely increase yields (Hartmann, 1958). Another study demonstrated that N availailability next to the olive tree roots, clearly favoured the growth of the branches, total production and size (quality) of fruits (Troncoso, 1996). Aguilar et al (1997) evaluated the effects of agricultural applications of compost to tree and bush crops. Preliminary results of this study showed that this application improved the fertility of the soil.

In order to evaluate the agricultural use of sewage sludge compost (SSC) it has been studied the effect of SSC on three parameters of the olive fruit.

MATERIALS AND METHODS

Fertilization Design

SSC was obtained from different wastewater treatment plants of Madrid. The study has been conducted since 1998. Four experiments were set up in an olive grove soil. Table 1 shows treatments (SSC; Urea, U; SSC + U; and Control, C) and its doses. Each experiment was replicated four times. All the treatments were placed on the soil between the rows of the trees and incorporated by means of harrowing in spring in 1998 and in 1999. The characteristics of the sewage sludge compost are presented in Tables 2 and 3.

Previous Analysis

The pH of SSC was measured on a 1:2.5 compost/water suspension. Compost electrical conductivity was determined on a further diluted 1:5 compost/water suspension. Organic matter was determined by the Walked-Black method (MAPA, 1986a). Total nitrogen was measured by standard Kjeldahl procedure (ALPHA, AWWA, WPCF, 1992). Phosphorus availability was determined by the Olsen method (MAPA, 1986b). KO, CaO and heavy metal Cu, Pb, Cr, Zn, Ni and Cd concentrations were determined by atomic absorption spectroscopy (AAS) after mineralization with HNO + HClO solution (Sims, 1991).

Controlled Parameters

Three parameters in olives were analyzed: heavy metals, humidity and fat content. Between December and January the olives were harvested and the parameters evaluated.

RESULTS

For statistical analysis of the results, the analysis of variance was used.

DISCUSSION

Figure 1 shows fat content in olives during the two years in study. In the first year no differences were found between treatments. But in the second year, olive tree fertilized with urea produced olives with the highest fat content. The average increase with regard to the other treatments was 12%.

With regard to humidity content, see Figure 2, in the first there was no significant differences between the four treatments. However, in the second year olives from olive tree fertilized with SSC and SSC + U were the highest in humidity content and the value was significantly higher with regard to urea treatment.

Table 4 shows statistical analysis of heavy metal content in olives. Heavy metals did not show significant differences except, Cu and Mn. Highest Cu values has been reach when SSC was used and it is statistically different from U treatment. For Mn, olives without fertilization showed the highest value. Hence heavy metals from SSC do not affect to heavy metal content in fruit of olive tree.

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Tables

Table 1. Characteristics of the treatments

Treatments	Doses
SSC	16.000 Kg of sewage sludge compost./Ha
SSC + U	250 Kg of urea./Ha + 8.000 Kg of sewage sludge compost./Ha
U	500 Kg. of urea /Ha
C	------

Table 2- Composition of the sewage sludge compost used in the trials

Humidity (%)		Organic Matter (%)		Oxidable Carbon. (%)		N (%)		P_2O_5 (%)		K_2O (%)		CaO (%)		E.C ($dS.m^{-1}$)		pH	
98	99	98	99	98	99	98	99	98	99	98	99	98	99	98	99	98	99
17.5	22.7	35	35	12.5	11.2	2.1	2.4	1.4	4	0.4	0.5	5.9	9.8	4.05	4.1	8.2	7.9

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Table 3. Heavy metals on sewage sludge compost (mg/Kg.)

	Pb		Cd		Ni		Cr		Cu		Zn	
	1998	1999	1998	1999	1998	1999	1998	1999	1998	1999	1998	1999
Seseña	122	55	<3	<3	48	32	233	105	268	130	1428	840
UE Limit	1200	40	400	1500	1750	4000						

Values in rows followed by the same letter were not significantly different at P=0.05

Table 4. Heavy metals on olives (mg/Kg).

	Fe	Mn	Cu	Pb	Zn
Control	56.5 [a]	5.0 [a]	4.2 [ab]	0 [a]	15.5 [a]
SSC	55.7 [a]	2.3 [b]	5.7 [b]	0 [a]	11.2 [a]
SSC + U	41.7 [a]	2.5 [b]	5.0 [ab]	0 [a]	10.7 [a]
U	46.2 [a]	3.5 [ab]	3.0 [a]	0 [a]	12 [a]

Figures

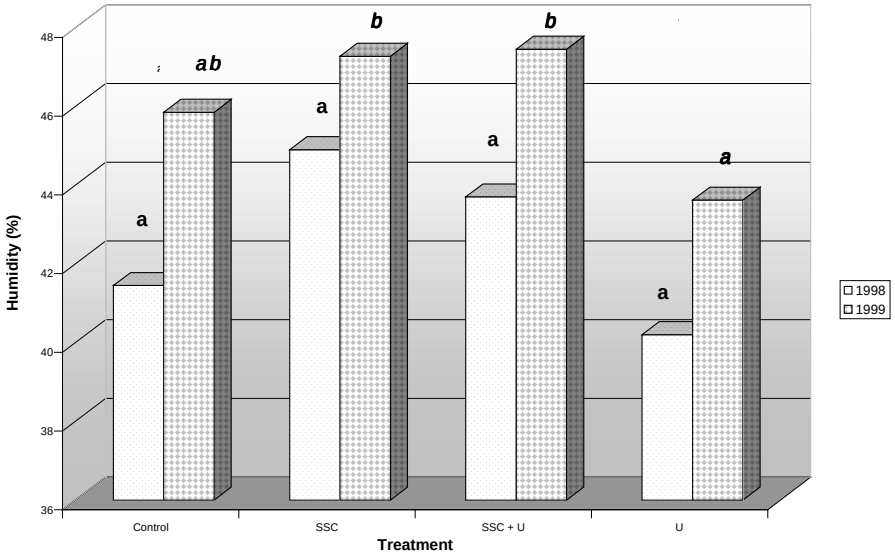

Fig. 1. Effect of treatment on Humidity content (%) in olives

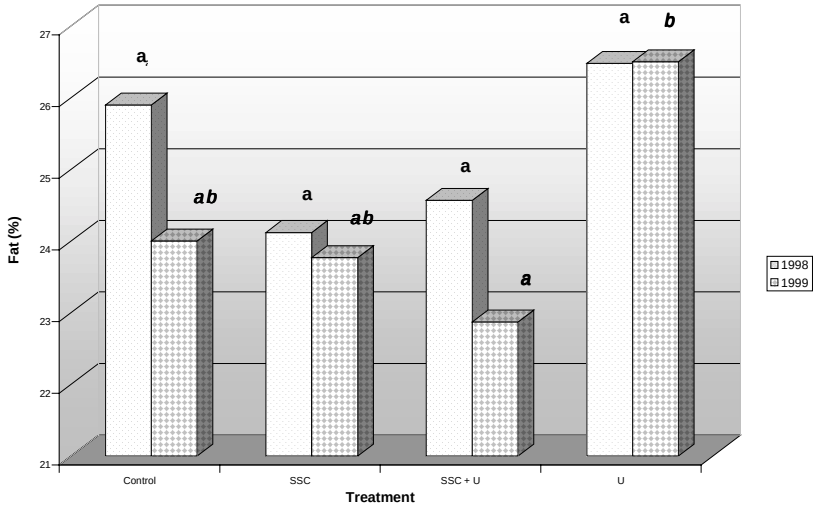

Fig. 2. Effect of treatment on fat (%) in olives