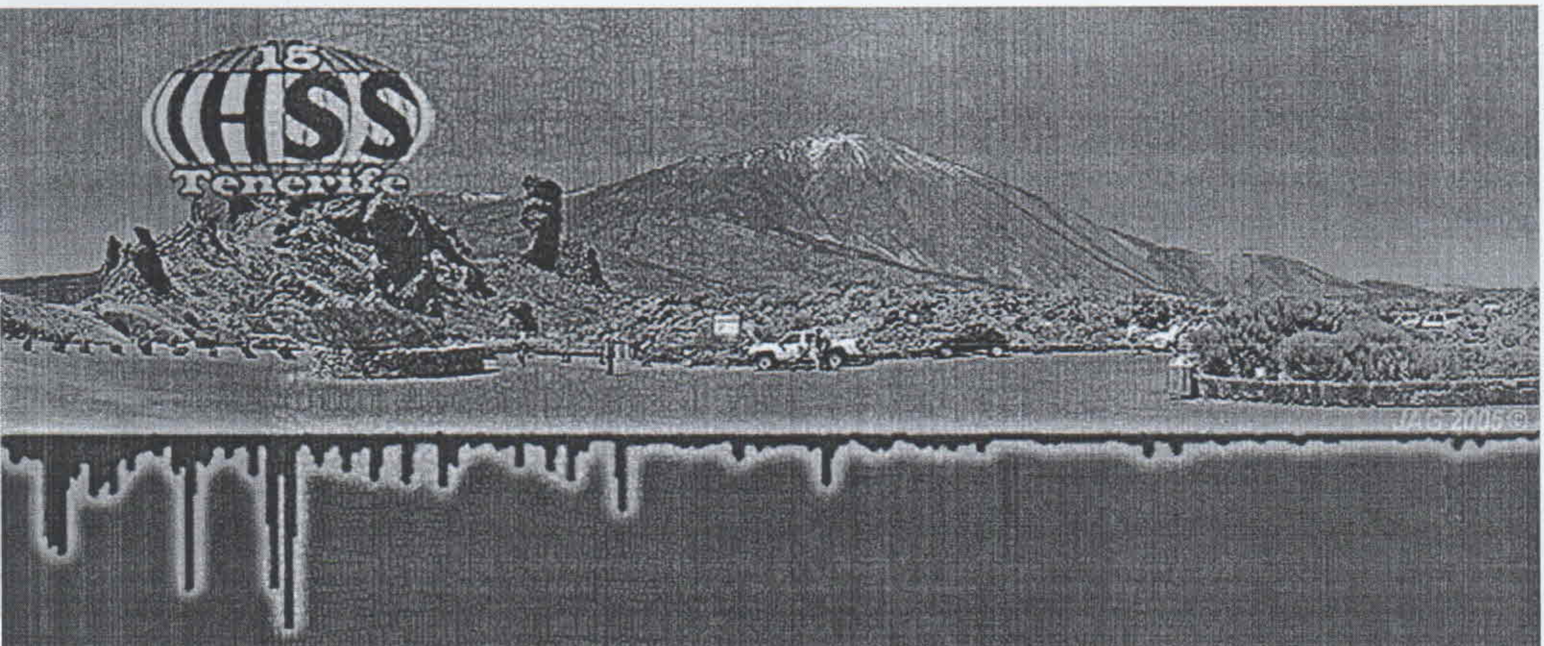

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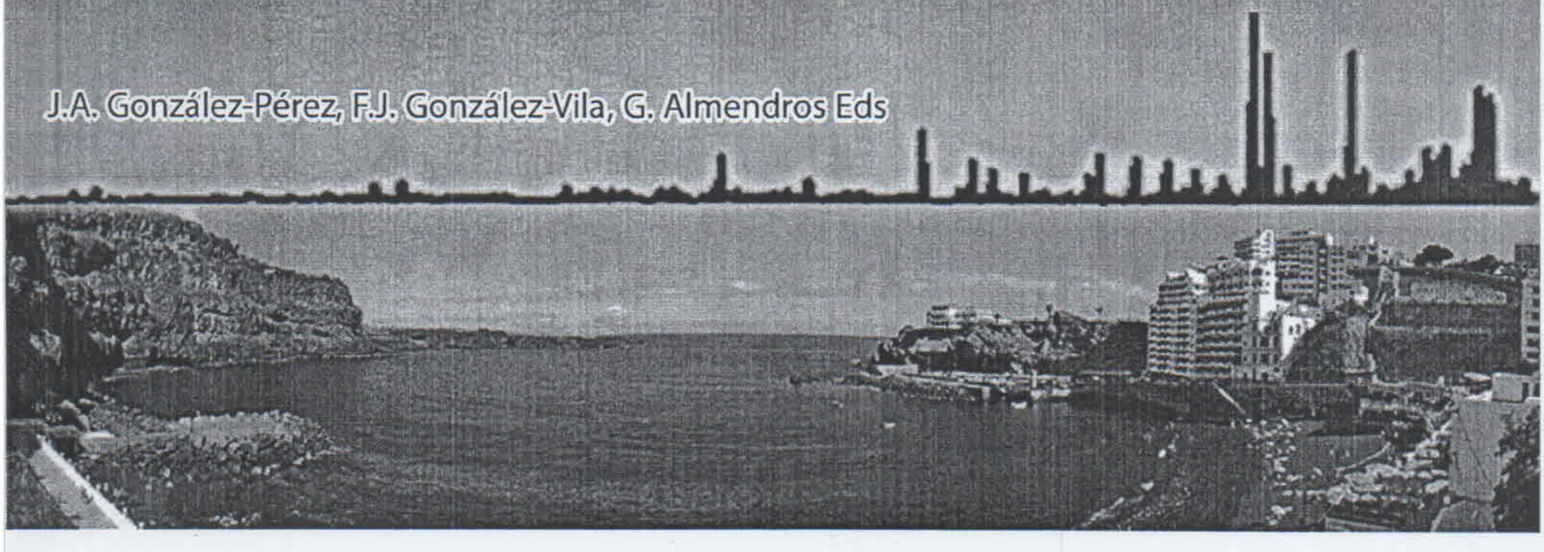

Characterization of Soil Organic Matter of Treated Sewage Effluent Irrigated Areas

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1. Introduction

The increasing on water sources demand in the cities has done man seek different sources for irrigation of crops, since agricultural activity consumes a large amount of this resource.

According to data from [6], it is estimated that approximately 65% of the water amount available in the national territory is targeted to the practice of irrigation of crops, while only about 17% is aimed for human consumption. This situation is worrying, once Brazil is a country with intense agricultural activity.

To [4] water represents a development limiting natural resource, both in agricultural and industrial activities, and has its quality breakdown by misuse and pollution, largely generated by direct discard of raw and treated effluents in water courses.

According to research accomplished by SABESP (Companhia de Saneamento Básico do Estado de São Paulo), only the city of São Paulo, by its STS (sewage treatment station), generates nearly 3,000 $L \cdot s^{-1}$ of TSE (treated sewage effluent). However, in the National Policy of Hidric Resources, there is no regulamentation about the use of waste water (such as TSE) in any activities.

In this way, the purpose of the following study is to evaluate the soil organic matter (SOM) of irrigated areas, comparing to non-irrigated area, analyzing about the sustainability of the TSE use in agricultural soils instead of water, as a contribution in a bigger thematic project.

2. Materials and Methods

This study is part of a multidisciplinary research group of thematic project about use of sewage effluent treated by biological process (stabilization pounds, UASB reactor / activated sludge) in agricultural soils, sponsored by Fundação de Amparo à Pesquisa do Estado de São

Paulo – and coordinated by Prof. Dr. Adolpho José Melfi (CENA-ESALQ/USP).

The project was initiated in January, 2003, and the experimental field was installed near to the STS in the city of Lins – SP, operated by SABESP, under cultivation of grazing and sugarcane. In this study were analyzed soil samples from the sugarcane area. The city STS is Australian kind (primary treatment in anaerobic pounds and secondary treatment in optional photosynthetic pounds) with flow rate of 140 $L \cdot s^{-1}$ and with mostly domestic sewage. The experimental arrangement of the sugarcane area was comprised by five treatment blocks with four repetitions. The irrigation with TSE was performed according to soil humidity, as it follows: SI: soil non-irrigated with TSE; 100: soil irrigated with TSE and soil humidity in the same level of field capacity; 125: soil irrigated with TSE and soil humidity 25% above field capacity; 150: soil irrigated with TSE and soil humidity 50% above field capacity and 200: soil irrigated with TSE and soil humidity 100% above field capacity. In this study were analyzed samples of the SI, 100 and 200 conditions. The soil samples were randomly collected, in three repetitions by analyzed condition, in May, 2006, in the depth till 100 cm, dried at room temperature and subsequently sieved at 0.5 mm mesh.

The carbon content analyses were carried out by dry combustion [5] in a LECO CN-2000 instrument, belonging to the Laboratório de Biogeoquímica of CENA/ESALQ. The LIF (laser-induced fluorescence) analyses were carried out according [3], in an instrument belonging to Embrapa Instrumentação Agropecuária.

3. Results and Discussion

The carbon content analyses for samples for the three different conditions examined showed decrease, in all depth consider, being more pronounced in areas subject to TSE irrigation, mainly in the 200 condition. The data obtained are illustrated in Table 1. This decrease is probably attributed to labile carbon fraction degradation, caused by the increase in microbial activity related to the action of TSE in the soil.

According to [1], the use of TSE as irrigation source may alterate the organic matter degradation rate, causing a decrease in the soil carbon content. The authors also remind that it may cause an alteration in the soil carbon cycling process.

Table 1: Carbon content obtained for soil samples subjected to three different types of treatment

	0–10	**10–20**	**20–40**	**40–60**	**60–80**	**80–100**
SI	0.97±0.01	0.96±0.01	0.74±0.01	0.64±0.01	0.54±0.01	0.46±0.01
100	0.88±0.01	0.86±0.01	0.70±0.02	0.54±0.01	0.53±0.01	0.42±0.03
200	0.86±0.01	0.82±0.01	0.70±0.01	0.58±0.02	0.52±0.01	0.44±0.01

This situation is worrying since represents, among other factors, loss of SOM, that may cause limitations in soil fertility and structure (taking into consideration its importance to the soil and culture and when it comes to a soil with less than 1% carbon content), and possible carbon loss as CO_2, causing increase in atmospheric greenhouse gases concentration, negatively contributing to the global warming scenario.

The obtained data by LIF spectroscopy, showed by Table 2 and Figure 1, are complementary to the carbon content data obtained, achieving excelent data correlation.

Table 2: Humification degree (H_{FIL}) obtained by Laser-Induced Fluorescence for soil samples subjected to three different types of treatment

	0–10	10–20	20–40	40–60	60–80	80–100
SI	527±5	487±4	718±43	990±7	1254±29	1568±77
100	548±6	566±9	831±16	1269±6	1289±29	1868±112
200	574±4	635±5	795±42	1141±15	1328±44	1711±154

In this way, its suggested that, in this case, the TSE use as irrigation source leads to an alteration in the soil organic matter degradation process, probably due to an increase in the soil microbial activity and, consequently, more labile carbon fraction degradation (as seen in the carbon content results), remaining the most recalcitrant organic matter fraction, harder to degrade. This most recalcitrant fraction leads to an increase in the organic matter humification degree, as detected by LIF.

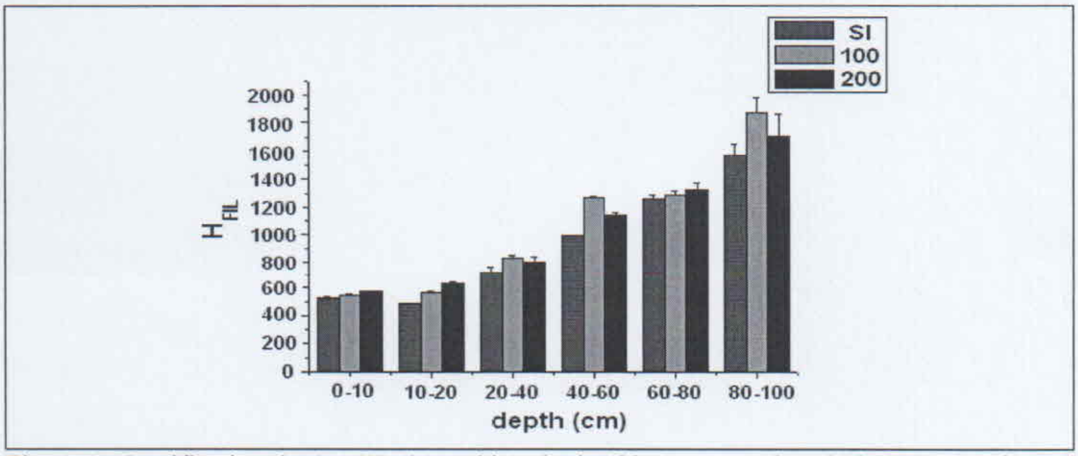

Figure 1: Humification degree (H_{FIL}) graphics obtained by Laser–Induced Fluorescence for soil samples subjected to three different types of treatment

However, the decrease in the organic matter carbon content was verified even with conventional irrigation with water, comparing to irrigation with TSE, in the same experimental field. In this way, it may be suggested that the soil itself has this intrinsic characteristic of organic content loss, probably due to increase in the soil microbial activity (even when irrigated with water), which is more accentuated when irrigated with TSE.

Otherwise, in his study about stability of organic carbon in deep soil layers controlled by fresh carbon supply, [2], observed that changes in agricultural practices, increasing the distribution of fresh carbon at depth, could lead to a loss of ancient soil carbon, which affects the present soil carbon content, promoting the priming effect in soil.

4. Conclusions

Proper weights and discussions about the results for the samples analyzed, it is concluded that, to soil conditions analyzed, the employment of TSE replacing the water used in agricultural activities for irrigation of crops is worrying and may bring limitations on soil structure and fertility, as evidenced by more pronounced decrease on the contents of SOM in samples for the areas under adding TSE, taking into account that is a soil with less than 1% carbon content and has negative response even to conventional irrigation with water.

It is suggested that, in this case, irrigation with TSE causes the priming effect in soil, observed by more accentuated decrease of carbon content in samples of the irrigated areas, comparing to the non-irrigated area, what may become an environmental problem.

Between the three irrigation conditions analyzed, it is verified a more pronunciated effect in the organic matter of samples belonging to the 200 condition (soil irrigated with TSE and soil humidity 100% above field capacity), as it showed by the lower carbon content and higher humification degree, comparing to the SI and 100 conditions.

However, the experiments must continue to confirm and validate the initials tendencies detected, and to search new alternatives for soil and culture tillage to make possible the TSE use and application in sustainable conditions.

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