# SEWAGE SLUDGE INFLUENCE UPON SOIL FERTILITY IMPROVEMENT

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## ABSTRACT

*Soil like culture is part of the environment in which the fertility momentary expression through a specific energy balance. On the hand, permanent reactions occur between soil phases (solid, liquid, gas), with release of energy, on the other hand the biological activity of plants (nutrient uptake, growth and development) makes various forms of energy and stored it. Sludge waste or processed or composted, representing organic fertilizer can contribute to amplification reactions due to the wealth of cultural soil organic matter (OM), commonly around 25 %. By using it in different doses (0-50 t.ha$^{-1}$) improved soil carbon (C) as the main chemical element of OM and humus, with macro- and microelements. Due to improved soil total organic carbon (TOC) crops like maize, wheat, soybean, have formed useful production (grains) in addition.*

## INTRODUCTION

As a whole culture soil has a degree of fertility, an essential feature in the process of feeding the plant. Status and degree of fertility is assessed through an energy balance characteristic includes all permanent reactions occur between the three phases of soil: solid, liquid and gaseous (Davidescu et Davidescu, 1981). Agricultural soil continuous reactions are subject to the law of mass action, the influence of some basic aspects, such as the chemical potential of nutrients, temperature changes, the use of fertilizers, water, microbiological activity, the effective life of the crop. The interplay of these factors lead to the release of energy required other physical, chemical and biological. Overall these actions more energy or not, leading to outline a very mobile nutrient balance (Chao et Harvard, 1987), i.e. dynamic equilibrium. At the same time, the soil is characterized by a content of organic matter (OM), which comes from different sources, including organic fertilizers (Dorneanu et Dorneanu, 1984). At some point OM are in various stages of decomposition or colloidal dispersion (Eliade, 1979). The main functions of OM in soil are an important source of nutrients, affect the physicochemical characteristics of soil material provides the energy necessary soil microflora and further helps conduct biochemical processes and nutrient mobility (Kolenbrander, 1974). Activity, effective biological life of the plant through which the uptake (absorption) of nutrients, together with the phases of grown and development, is one of the most important processes for conversion of various forms of energy between them. Interesting is the fact that these forms of energy is subject to the laws of thermodynamics. The existing soil with OM and gained organic fertilization, is the part of agricultural ecosystems in which crops are the main energy carriers (Jansson, 1967). OM through various complex processes gradually turns into humus, soil fertility expressing product. Depositary in the soil humus is the primary energy and chemicals to the plants low entropy related by photosynthesis (Borlan, 1994). In order to improve crop soil organic matter (OM) as required whole complex of processes by which crops benefit from food rich in macronutrients and micronutrients, was used for sludge disposal, so as to process (L'Hermite et Ott, 1983) and compost. Being an organic material such as manure, sludge waste has helped to improve soil carbon, the chemical elements represented in OM and that rich in humus (Borlan, 1994). Research conducted with different doses of sludge, both, have shown positive developments, important, and in response to these conditions and yields obtained have evolved similar.

## MATERIAL AND METHODS

In the period 2004-2010 were carried out complex agricultural experiments. In a first stage plants were cultivated into a field structure: maize, winter wheat, soybeans and wheat, using doses of processed sludge waste treatment plant of Piteşti in doses of 0, 5, 10, 25 and 50 $t.ha^{-1}$. For a better digestion of the sludge has been used and nutrient three fractions: 0, fertilized chemically necessary ½ to 1/1 of optimal doses. Processed sludge doses were applied to maize in the first year and were repeated in the second year for wheat. Effect of residual sludge was observed in soybean and wheat crop in the last two years. In another step to cultivate maize groing in pots and in the field, using compost waste sludge from the same source, the same dose but different composting processes: a precess of composting ECOIND held in Bucharest, and the second composting process within the resort Piteşti agricultural research and development (after Bruce et Newmann, 1992). Chemical fertilizers were applied at the same doses: 0, ½ and 1/1 of the needs. The experimental variants were each 100 $m^2$ where processed slurry, each 700 $cm^2$ in vegetation vessels and one 25 $m^2$ for compost sludge. The number of repetition was 3 in the case of processed sludge and 5 and 4 repetitions maize composted sludge. During the stage of maturity the plants were harvested and the production of grain per hectare obtained was reported for the first stage and the production of maize grain on the average plant in the next step. Samples of the original slurry, both types were analyzed in accordance with ISO 13877-99. Macronutrients such as total nitrogen (tN,%), phosphorus ($P_2O_5$) and potassium ($K_2O$) were analyzed by the following methods: tN by STAS 7184/2-85, phosphorus by STAS 7184-79, and potassium with STAS 3223/21-92. Soil samples were collected from agrochemical deep surface soil horizon: 0-20 cm in all the repetitions of the experiment. For these repeats to average the samples were made that chemical abalysis (Baizi, 1988). The chemical analysis of total organic carbon (TOC) was carried out according to ISO 13877-99. Research data obtained were processed statistically by means of analysis of variance (Anova test) and for the correlations and regressions using Excel.

## RESULTS OBTAINED

The content of macronutrients of sludge processed and composted

The sludge analysis were carried out several periods, in advance, in order to observe its classification within the legal requirements. Limits obtained strenghths average total organic carbon (TOC) and the macronutrients is considered good. Values shown are considered to be appropriate and useful for organo- mineral fertilization proposed (Table 1).

**Table 1.**

**Macroelements contents from processed and composted sludge**

| Chemical elements | Limits | Media |
|---|---|---|
| TOC, % | 23,42 – 30,11 | 26,16 |
| tN, % | 2,24 – 4,32 | 3,51 |
| $P_2O_5$, % | 1,25 – 5,13 | 2,57 |
| $K_2O$, % | 0,18 – 2,88 | 0,81 |

Influence of sludge doses on the content of total organic carbon (TOC) in the soil

With the increasing application rates, both domestic processed sludge and sludge compost, soil culture improved chemical element carbon content- Figure 1 and Figure 2.

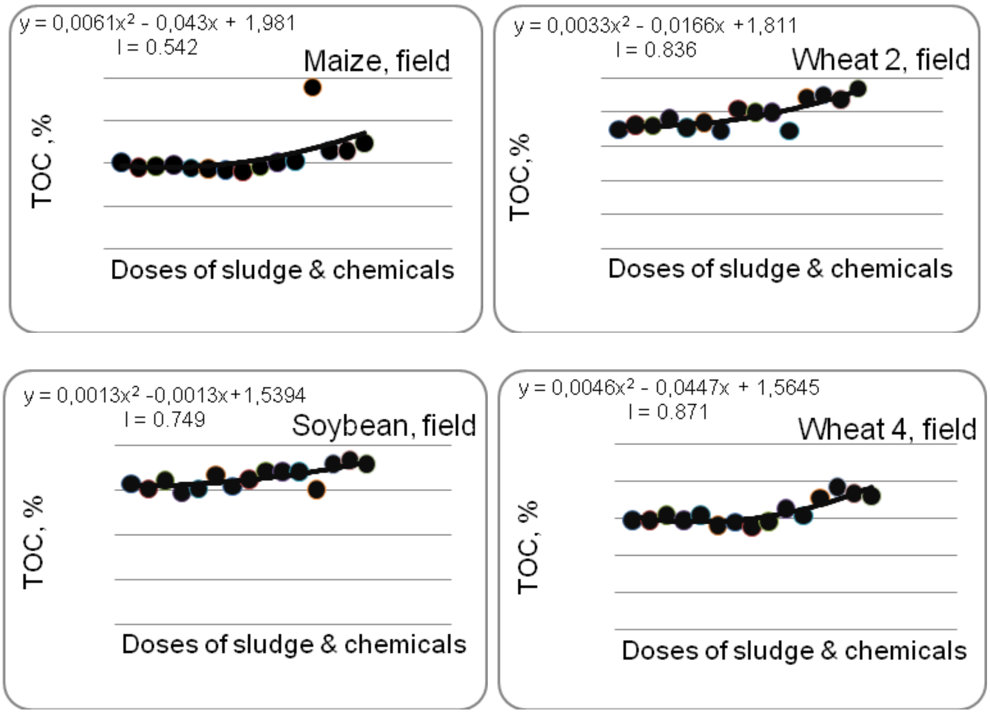


**Fig. 1. Evolution of TOC concentrations from the soil treated with processed sludge doses & chemical fertilizers**

In all four graphs (Figure 1) shows that by organo- mineral fertilizer doses of sludge formed with chemical doses, increasing soil culture was enriched in total organic carbon (TOC). The first year maize TOC increased from about 2 % up to 2.6 %- according to the equation. Winter wheat in the second year, amid new dose application of sludge, TOC increased from 1.75 % to 2.4 %. In both cases observed direct effect of two doses of sludge applied to field: maize and wheat sophomore. Soybean third year of TOC content between 1.5 % and 1.8 % TOC and wheat in the past year between 1.5 % and 1.9 % TOC. The two plants have had/ showed the effect of soil residual waste sludge culture.

State of the soil fertilized with composted sludge showed some characteristic features (Figure 2).

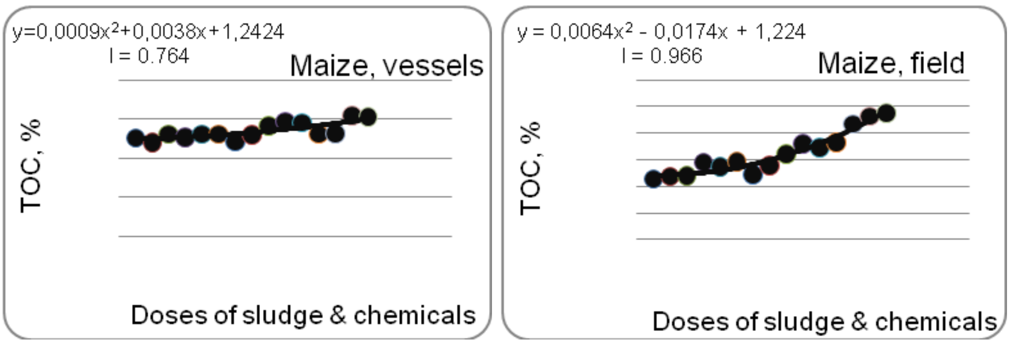


**Fig. 2. Evolution of TOC concentrations from the soil treated with composted sludge doses & chemical fertilizers**

TOC concentrations evolved positively in both cases, but with absolute values ranging from 1.25 % to 1.5 % for vessels vegetation and between 1.1 % and 2.4 % of the maize grown in field research. Remember that the relatively lower values of TOC in the first variant (witness without fertilizers) are due to the choice of a poor groung as this organic carbon, ie less fertile, to express as clearly influence this product: compost of sludge treatment. Both statements obtained by both doses of sludge processed and composted demonstrates growth, accumulation of this valuable component- sewage sludge to increase soil organic matter content (OM) and the components of humus, the final product expression of soil fertility/ medium.

Expresion levels of grain production under fertilization with sewage sludge

Being created conditions to improve soil organic matter content with this valuable product, was expected that plants react as favorably, by upbringing and development (Douglas, 2003). Periodic observations on the morphology of plants grown in the 15 combinations of sewage sludge with chemical fertilizers have been found to increase more or less obvious. These states were expressed in a final phase with accumulation of plant biomass. From a practical standpoint, and therefore economic interests as biomass accumulation result in the production of grains bigger. The following charts highlight how increased grain yields by increasing doses of sludge (Figure 3 and Figure 4). As expected, by improving the soil with organic fertilizers: processed and composted sludge, grain production plants formed more. From these graphs show that sludge increased maize grain yield from about 6 to about 8 $t.ha^{-1}$. Sophomore wheat produced between about 4 to 7 $t.ha^{-1}$ grains. Soybean size between 1.4 and 2.2 $t.ha^{-1}$. In the last year (4) wheat that production increased from 3 to 4.3 $t.ha^{-1}$. With increasing doses of sludge compost product to increase the production of maize, both in vessels and in the field. Maize grown in plots of vegetation produced between about 44 and 82 $g.plant^{-1}$, and the experimental field between 200 and 225 $g.plant^{-1}$.

## CONCLUSIONS

Sewage sludge processed or composted contains important nutrients, all useful for ensuring agricultural environment to increase the specific energy capacity. The doses studied to favor the accumulation of organic matter (OM) with the decisive role in the activation and amplification of biological and physico-chemical processes which were made available plants nutrients increased concentrations of ions ranging from macro- and micro-elements.

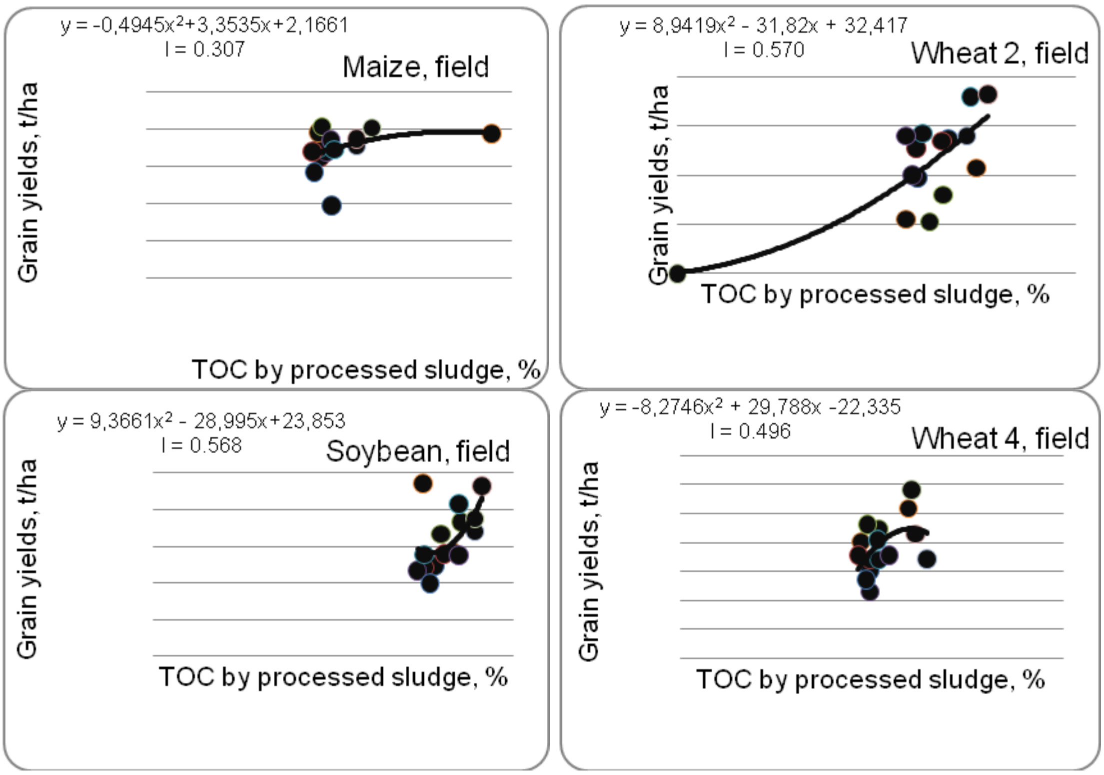


**Fig. 3. Correlations between TOC and field plants grain yields**

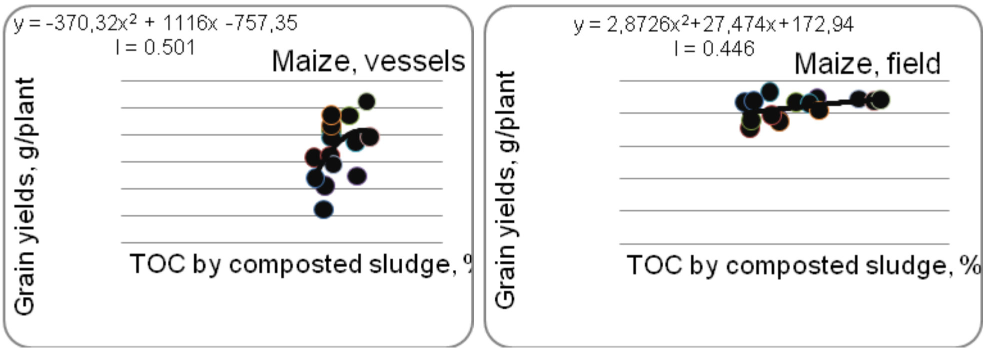


**Fig. 4. Correlations between TOC and vessel/field maize plants grain yields**

Accumulation of OM from agriculture improved mud expressed as concentrations of total organic carbon (TOC,%). TOC of processed sludge accumulated in the first two years as a direct result, 0.7 %, and in the next two yeasr as a residual effect, by 0.4 %. TOC sludge compost increases experienced by direct application between 0.3 % and 1.3 % growing in vessels and in the field.

Plant response to the generation of different seeds in all six cases considered, due to the specific growing conditions, thus confirming the relative uncertainty in the case of slurry applied to the relation between the dose and the formation of useful production (such as grain).

Doses of mud processed (between 0-50 t.ha$^{-1}$) increased production of maize with 1.5 t.ha$^{-1}$ in the first year, the wheat with 3.0 t.ha$^{-1}$ in two, the soybean 0.9 t.ha$^{-1}$ and that of wheat last year, up to 1.3 t.ha$^{-1}$ grains.

Doses of sludge compost (between 0-50 t.ha$^{-1}$) contribute to the formation of maize in addition to 30 g.plant$^{-1}$ both in the growth vessel and where it was cultivated in the experimental field.

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