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STUDY ON THE SLUDGE CAPITALIZATION AS A FERTILIZER FOR ORNAMENTAL GARDEN PLANTS

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ABSTRACT

The paper aimed to demonstrate that the sludge from wastewater treatment plants can be used efficiently as a fertilizer in horticulture because in the near future the storage of this sludge will become a problem. For this reason, we approached the study on the recovery of the sludge from the wastewater treatment plant of Brăila as fertilizer in the crops of ornamental garden plants that are not intended for consumption. The correct management of the sludge from wastewater treatment plants may bring a positive contribution to the vegetation development rate. The main objective of the sludge treatment is the capitalization and the decrease of negative impact on the environment.

KEYWORDS: wastewater, sludge, ornamental plants, fertilizer

1. Introduction

There are a number of scientific researches whose main objective is to identify economical and non-polluting solutions for the recovery of the sludge resulting from the wastewater treatment process. Thus, at the national level these concerns have materialized in the form of scientific papers, doctoral theses, monographs.

A PhD thesis [1] has investigated experimentally the possibility of dewatering the sludge from wastewater treatment by three methods of reducing its volume, as follows:

- alternative freeze-thaw cycles;
- chemical conditioning according to the KemiCond recipe followed by mechanical dehydration;
- microwave irradiation.

Another PhD thesis [2] studied the problem of the influence of sludge from urban wastewater treatment plants on lucerne (Medicago sativa) culture.

The increase of the urban population of Romania, but also requirements of the European Community regarding the recovery of the urban waste, have led to finding solutions for the implementation in the agricultural production systems of the urban sludge.

This sludge contains nutrients necessary for plant growth, and their use retains the phosphates' mineral reserves on which the phosphorus fertilizers are prepared. The physical, chemical and biological soil properties are improved by using this sludge. Although the fertilizing value of the sludge is generally recognized, the generalization of its use in agriculture has some objections regarding hygienic and sanitary aspects as well as the presence of unwanted elements such as: heavy metal compounds, pesticides and some non-degradable organic substances.

At the base of all sludge treatment processes are two distinct technological processes: the stabilization of the sludge by fermentation and the sludge dehydration. Most wastewater treatment plants in Romania are provided with mechanical and biological stages. The mechanical stage includes: the rare and thick grills, slime separator, pumping stations, primary decanters. Biological stage is composed of: aeration tanks, secondary decanters, pumping station, recirculated sludge and excess sludge. In most cases dewatering sludge from sewage treatment plants is carried out on drying beds. The new projects provided for the sludge dewatering by mechanical methods of centrifugation and press filters.

Regarding the heavy metals, the Directive 86/278/CEE stipulate for the concentration values in soils receiving sewage sludge, also their concentration in sewage sludge intended for agriculture capitalization and the annual maximum quantities of heavy metals that can reach agricultural soils.

The sludge from wastewater treatment with a composition similar to urban wastewater can be used in agriculture only if they comply with the present

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technical norms. On the agricultural lands can be applied only sludge with a certain content in polluting elements that do not exceed the limits of Table 1 [3].

Table 1. *The Maximum admissible values of heavy metals from sludge intended for use in agriculture (mg/kg dry matter)*

Parameters	**Values**
Cadmium	10
Copper	500
Nickel	100
Plumb	300
Zinc	2,000
Mercury	5
Chromium	500
Cobalt	50
Arsenic	10
AOX (sum of organohalogenated compounds)	500
PAHs (polycyclic aromatic hydrocarbons)	5
Polychlorinated biphenyls (PCBs)	0.8

The sewage sludge producers shall regularly provide for the sludge users the sludge supplies and characteristics as follows: pH, humidity, loss of ignition at 550 °C (volatile substances in suspension), total organic carbon, nitrogen, phosphorus, potassium, cadmium, chromium, copper, mercury, nickel, plumb, zinc.

The sewage sludge application is allowed only in the period characterized by a regular access on the land and the soil sludge incorporation promptly after application.

The following rules are applied in the use of sludge:

- the nutritional requirements of the plants;
- the quality of soils and water surface will not be affected;
- the pH value of soils on which the sewage sludge will be applied should be kept above 6.5.

2. Materials and methods

The sewage sludge from the wastewater treatment plant of Braila was used in order to find its influence on the growth rate of ornamental garden plants. The sludge was already dehydrated when it was brought to be mixed with soil in different proportions.

The humidity and sun exposure conditions were the same. In each flowerpot were planted two seedlings.

The seedlings of ornamental plants Gazania talent yellow were planted on May 6, 2017 in number of 12, at the same vegetation stage as follows:

a. Variant V1 - 3 flowerpots 85% filled up with fertile soil and 15% sewage sludge, Fig. 1.

b. Variant V2 - 3 flowerpots 90% filled up with fertile soil and 10% sewage sludge, Fig. 2.

c. Variant V3 - 3 flowerpots 95% filled up with fertile soil and 5% sewage sludge, Fig. 3.

d. Variant V4 - 3 flowerpots filled up with fertile soil, Fig. 4.

Fig. 1. *Variant V1-the initial seeding phase*

Fig. 2. *Variant V2 - the initial seeding phase*

Fig. 3. *Variant V3 - the initial seeding phase*

Fig. 4. *Variant V4 - the initial seeding phase*

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Fig. 5. *Variant 1, 2, 3, 4 –overall view of the initial seeding phase*

One of the chosen parameters for the comparative assessment of the plants growth rate of the four variants is the plant’s epigean part. Thus, after planting the twelve seedlings of Gazania talent yellow, the plant’s epigean parts were measured as seen in Table 2.

Table 2. *The length of the plant’s epigean part at the planting date*

The length of the plant’s epigean part												
Date of measurement: 06.05.2017												
Variant No.	V1			V2			V3			V4		
Seedling No.	1	2	3	4	5	6	7	8	9	10	11	12
Seedling 1 -left	70	75	55	65	100	70	85	75	70	65	90	75
Seedling 2 -right	60	60	65	65	100	80	95	95	60	75	85	80

Based on the average values (Table 3) the chart for the differences assessment regarding the growth rate of the plants have been achieved.

Table 3. *The length of the plant’s epigean part one month after planting*

Date of measurement: 06.06.2017												
Variant No.	V1			V2			V3			V4		
Seedling No.	1	2	3	4	5	6	7	8	9	10	11	12
Seedling 1 -left	80	100	120	dry	160	140	160	90	150	170	140	120
Seedling 2 -right	100	135	135	dry	150	85	150	135	105	150	160	150

The most important percentage increase was the seedings from the control sample followed in descending order by variants 1, 3 and 2.

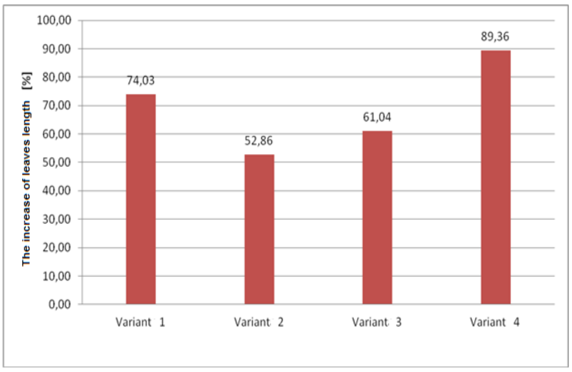

Fig. 6. *The percentage increase of the epigean part for the four variants*

3. The study results

At 50 days after planting, four representative flowerpots were selected from the four variants, namely flowerpot 2, 6, 8, 12, and a typical plant from each flowerpot was selected.

Fig. 7. *Variant V1 - end of growing season*

Fig. 8. *Variant V2 - end of growing season*

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Fig. 9. *Variant V3 - end of growing season*

Fig. 10. *Variant V4 - end of growing season*

Fig. 11. *Variant 1, 2, 3, 4 - end of growing season*

For the four plants the following growth - related parameters of the plants of Gazania Talent Yellow were evaluated:

- the flower number;
- the flowers diameter;
- the length of the flower shank;
- the length of the epigean part of full-blown leaves;
- the length of the epigean part of decorative flowers.

In order to provide a better possibility of comparing the results from evaluation of the parameters, they will be presented in a table for the four cases considered.

The characteristic parameters for the Gazania flowers were the following:

- the number of blooming flowers;
- the number of flower buds;
- the flowers diameter;
- the length of the flower shank;
- the shank flowers mass.

Table 4. *The characteristic parameters of the Gazania flowers*

Variant No. / % sludge	Number of blooming flowers [piece]	Number of flower buds [piece]	Flowers diameter [cm]	Length of the flower shank [cm]	Shank flowers mass [g]
2 / 15% sludge	3	3	5,3	13,5	14,6
6 / 10% sludge	3	0	5	12	17,3
8 / 5% sludge	4	2	5,3	12,5	16,2
12 / control sample	3	0	5	14,4	8

flowerpot 2

flowerpot 6

flowerpot 8

flowerpot 12

Fig. 12. *The typical plants of the representative flowerpots*

Considering the results set out above, it can be stated that the variant using just 5% sludge (Table 4) had brought the best results regarding the characteristic parameters of the Gazania flowers.

The variant with the most decorative leaves is the one that has in the substrate composition a percentage of 5% sludge (Table 5). It should be mentioned that the variant with the most mature and decorative leaves is the one with 15% sludge in the composition.

The analysis of the obtained values reveals that from a mass point of view the mixture with a percentage of 5% sludge (Table 6) favored the development of the plants planted in it.

Table 5. *The characteristic parameters of the Gazania leaves*

Flowerpot No. / % sludge	Number of mature leaves [piece]	Number of decorative flower [piece]	Mature leaves mass [g]	Decorative leaves mass [g]
2 / 15% sludge	13	27	5,6	14,8
6 / 10% sludge	5	26	3,7	24,8
8 / 5% sludge	4	26	1,7	34
12 / control sample	6	3	2,9	1,1

Table 6. *The plants weight parameters*

Flowerpot No. / % sludge	The root mass [g]	The whole plant mass [g]
2 / 15% sludge	5,6	39,2
6 / 10% sludge	2,9	50,2
8 / 5% sludge	4,4	56,5
12 / control sample	1,4	13,4

4. Conclusions

The proper management of the sludge from the wastewater treatment plants can bring a positive contribution to agriculture, which is also obvious from the work carried out. Using small percentages of sewage sludge mixed with the soil can bring encouraging results. When used in large percentages, sludge is not a viable solution for plant development.

Considering that in the near future the sludge from municipal wastewater treatment plants will no longer be able to be deposited in landfills, it is imperative to identify alternatives for its capitalization.

The use of sewage sludge as a fertilizer for garden decorative plants can be a solution for capitalization only for part of its volume. As for garden decorative plants, the pathogenic potential of the sludge used as fertilizer is eliminated.

The experimental part carried out in this work pointed out that the mixture obtained from 5% sewage sludge and 95% fertile soil ensures the most favorable development for the Gazania Talent Yellow ornamental plant. This finding recommends the use of sewage sludge as a fertilizer for ornamental plants planted in specially designed spaces in the municipality of Braila. As a safety measure, in order to prevent the direct contact with the sludge it is proposed that the mixture of the sludge and soil it is covered with a layer of fertile soil with a thickness of 50-60 mm.

References

[1]. Iorgulescu M., *Tratarea nămolurilor provenite de la statiile de potabilizare a apei*, Teză de doctorat, Facultatea de Hidrotehnică, Universitatea Tehnică de Construcţii din Bucureşti, 2015.

[2]. Pintea I. I., *Cercetări privind influenţa nămolurilor de la staţiile de epurare orăşeneşti asupra culturii de lucernă*, Teză de doctorat, Universitatea de ştiinţe agricole şi medicină veterinară Cluj-Napoca, 2012.

[3]. ***, *NORME TEHNICE din 16 august 2004 privind protecţia mediului şi în special a solurilor, când se utilizează nămolurile de epurare în agricultură.*