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EVALUATION OF THE TETRACYCLINE EFFECTS ON THE AROMATIC PLANTS WITH ANTIMICROBIAL ACTION

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Introduction

The increasing presence of antibiotic residues in the environment has been the result of an extensive use of a wide range of antibiotics in clinic sector and in animal husbandry.

Statistics indicated that antibiotic amount used in animal husbandry was significantly larger compared to the clinic sector. Most of antibiotics amounts used in human and animal therapy enter into the environment through urine and feces, raising the need to optimize and/or limit antibiotic use to minimize the environmental pollution. Agricultural fields have been fertilized with manure containing antibiotics. At the same time, crops have been irrigated with wastewater containing significant amounts of antibiotics because wastewater treatment processes are inefficient in removing antibiotics. In addition, the antibiotic could induce antibiotic resistant microorganisms which could also disturb plant and crop physiological processes. To assess the negative impacts of the antibiotics on the environment, toxicity tests were conducted on plant biological models, based on their germination processes and root growth. These tests aimed to evaluate the effects of antibiotic residues on plants or crops, providing valuable insights into the potential harm caused by environmental contamination with antibiotics.

Materials and methods

A culture soil procured from SC Florisol Product, Botosani was used to grow the plants. Tetracycline was procured from SIGMA-ALDRICH, lot 0000207104, with a purity of 98.0-102.0% (HPLC grade). Evaluation of tetracycline's effects on seed germination were performed on ten seeds from sage (Salvia officinalis), rosemary (Rosmarinus officinale), parsley (Petroselinum crispum) and thyme (Thymus serpyllum) (produced by SC AGROSEL SRL, Cluj-Napoca, Romania). The seeds were grown in absence (control samples, irrigated with water) or tetracycline presence of 0.6 mg/L and 1.2 mg/L, respectively. Control (1) observed the germination process, while control (2) monitored the development of the root growth. The experiment involved conducting tests in germination plates that had

unique flat and shallow transparent compartments. The plates were positioned vertically in a holder and kept at a temperature of 25°C. Initially, each plate had 50 grams of soil soaked with a 30-milliliter tetracycline test solution. The evaluation of the experiment was done on day 5 by monitoring the germination rate and on day 20 by monitoring the germination rate and measuring the root growth.
The first concentration of tetracycline used in tests, 0.6 mg/L was established according to the specialized literature, taking into account the amounts of antibiotics found in agricultural soils and manure. In order to highlight the effects of surpassing this value, testing was also conducted at a concentration twice as high, namely 1.2 mg/L.
The parameters determinate for soil substrate were: 7.0 - pH, 70% dry matter, 1.7% N 0.21% P, 0.82% K, 34.48% organic matter, 13.96% organic carbon.

Results and conclusions
Overall, germination rate on day 5 indicated a slight decline in the germination rate, up to 20%, as the tetracycline concentration increased.

Table 1. Effect of tetracycline on seed germination and root growth from aromatic plants

Species	**Concentration** mg/L	**Germination rate%, day 5**	**Germination rate% - day 20,** % control (1)	**Root growth day 20 (mean), mm** control (2)
Rosmarinus officinale	0.6	60	80	4.78
	1.2	50	60	4.45
Salvia officinalis	0.6	80	90	7.94
	1.2	70	70	7.55
Petroselinum crispum	0.6	50	60	7.25
	1.2	40	40	7.04
Thymus serpyllum	0.6	50	70	5.00
	1.2	40	50	4.80

(1) Germination for control at day 20 was: rosemary (*Rosmarinus officinale*) = 90%, sage (*Salvia officinalis*) = 90%, parsley (*Petroselinum crispum*) = 70% and thyme (*Thymus serpyllum*) = 80%.
(2) Root growth for control was for rosemary =5 mm, sage = 8.22 mm, parsley = 8.22 mm and thyme = 6.22 mm.

The results obtained in day 20 indicated that a higher tetracycline concentration had a more negative impact on the germination rate compared to lower tetracycline concentration. Such that for all four plants, doubling the concentration resulted in a 20% inhibition of the germination rate. Some variations could be observed among different plant species for the same tetracycline concentration. The highest germination rate was recorded by sage with a germination rate of 90% for control, 80% (day 5) and 90% (day 20) for concentration of 0.6 mg/L and 50% (day 5) respectively 60% (day 20) for concentration of 1.2 mg/L. Sage was followed by rosemary with a germination rate of 90% for control, 60% (day 5) and 80% (day 20) for concentration of 0.6 mg/L and 50% (day 5) and 60% (day 20) for concentration of 1.2 mg/L. For thyme, it was registered a germination rate of 80% for control, 50% (day 5) and 70% (day 20) for concentration of 0.6 mg/L and 40% (day 5) respectively 50% (day 20) for concentration of 1.2 mg/L. The lowest germination rate was recorded by parsley with a germination rate of 70% for control, 50% (day 5), respectively 70% (day 20) for concentration of 0.6 mg/L while for concentration

of 1.2 mg/L the rate of germination was 40% (day 5) and 50% (day 20). Root growth on day 20 indicated a similar germination rate pattern, higher concentrations of tetracycline tended to have a more negative effect on root growth. The data suggested that the longer plant exposure to tetracycline, the more pronounced the impact on root growth became. For all four plants exposed to the double dose of 1.2 mg/L, a reduced root length was recorded. In summary, the results suggested that higher concentrations of tetracycline had a stronger negative impact on the germination rate and root growth. Moreover, prolonged exposure to tetracycline appears to exacerbate the negative effects on root growth.

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