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New method of tomato fertilization with the use of chosen nanoparticles

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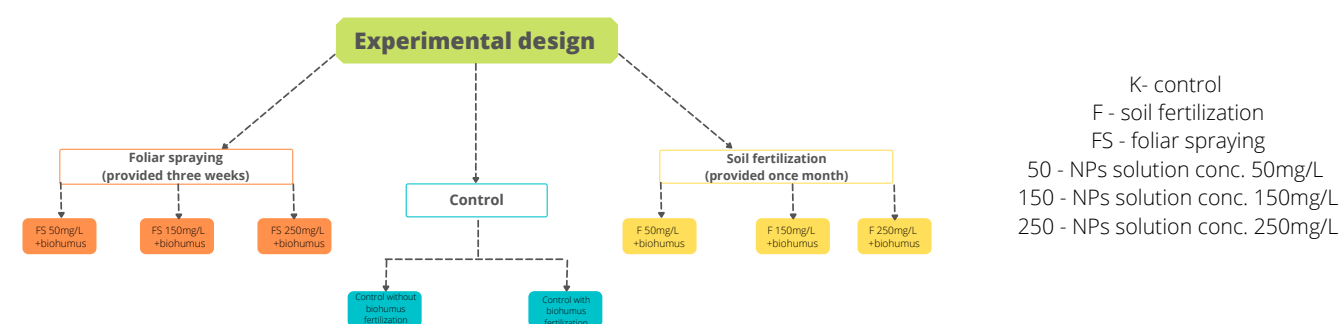
Introduction

The fast development of world population in the past few decades has forced the agricultural sector to increase crop productivity to satisfy the needs of billions of people, especially in developing countries. The agriculture zones are reaching the limits of natural materials like stagnation in crop yield, declining soil organic matter, water availability. This situation is forcing the industry to double the food production to fulfill the humans needs. While the most favorable for crop growth is soil, the open field agriculture might face serious problems such as availability of land, agriculture productivity or environment pollution. The huge problem for proper agriculture is the low efficiency and the environment contamination cause by wide use with conventional bulk fertilizers. Basic fertilizers are nitrogen- and phosphorus-based and both these compounds can easily change their chemical forms for the ones which are not accepted by plants. Consequently, large number of fertilizers is lost to atmosphere or surface water bodies, causing the pollution. They can be also washed by rains into rivers and lakes, where they cause contamination. There is other way of manuring the soil such as use of nanofertilizers.

The aim of this study was to develop a new method of soil fertilization with the use of nano zinc oxide (nano-ZnO). The main assumption of this research was the examination and comparison of the influence of certain concentration of nano-ZnO (50mg/L, 150mg/L, 250mg/L) on seedling and growth of tomatoes (*Solanum lycopersicum*). Firstly, the parameters crucial for the process of seedling were examined after conducting the research on the influence of nano-ZnO (nanoparticles <100nm and <50nm) on different tomatoes cultivars. Moreover, the other parameter that will be taken under the consideration is the improvement of plants ability of macroelements assimilation from conventional bulks fertilizers. The solutions of nanoparticles were applied into the soil or by foliar spraying. Additionally, the parameters such as antioxidant activity, the content of sugars and allergens in tomato fruits will be tested. Preliminary observation indicates that solutions of nano-ZnO have significant influence on tomato germination and growth

The influence of NPs on tomatoes growth

The first step of the procedure was the sterilization of seeds (cultivar A „Maskotka”). Seeds were put into soil and were watering every 2-3 days. All the seeds (except the controls) were treated with chosen fertilizer and some of them were treated with the different concentration of nanoparticles solution (NPs size ≤50nm) placed in the soil or by foliar spraying. The foliar spraying was implemented after first month of cultivation. First four days after sowing the pots with tomatoes seeds were placed in dark place, afterwards day/night cycle (16h/8h). The plant cultivation was carried out for six months.



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Ongoing analysis: the parameters such as antioxidant activity or the level of allergens in tomato fruits are currently tested. **The chosen analysis are:** determination of chlorophyll and plant pigments concentration, the total polyphenol content, the content of flavonoids, the catalase activity, the superoxide dismutase activity, the pyrogallol peroxidase activity and the content of nitrogen, phosphorus and potassium in green part of plants.

Conclusions

Preliminary statistical calculation indicates that the size of nano-ZnO has influence on the growth and germination of tomato seeds. The acquired data suggests that the selected concentrations of the nano particles in solutions notably affect the germination rate, depending on the chosen tomato cultivar. The preliminary observations from the study on tomato growth suggested that soil fertilization is more beneficial for the plants, even though the differences between the foliar spraying and soil fertilization were not significant at the last stage of cultivation. The main focus of the ongoing research is the determination of several chosen parameters of the plants such as content of pigments, polyphenols and antioxidants. However, the results are equivocal, therefore more research will be done to further confirm the conclusions. Moreover, the above-mentioned chosen parameters still require a thorough investigation and analysis.

The analysis of seed germination

The aim of this part of study was to examine the influence of ZnO nanoparticles on germination of seeds of 3 different tomato cultivars. In this research we used ZnO nanoparticles with two different sizes (≤100nm and ≤50nm). Additionally, the solutions of NPs were prepared with different concentrations.

The study was conducted for 6 days. Seeds were sterilized and placed on filter paper in Petri dish. 3mL of chosen solution (NPs or water) was added to all Petri dishes. Samples were kept in the dark place for whole period of germination.

K- control
50 - NPs solution conc. 50mg/L
150 - NPs solution conc. 150mg/L
250 - NPs solution conc. 250mg/L
A,B,C - cultivars

