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PET Microparticles Has Severe Toxic Effects to *Arabidopsis thaliana* in Hydroponic Cultivation

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Extended Abstract

Plastic microparticles and nanoparticles are growing invisible threat. Estimates speak of a threefold amount of plastics in the year 2050 compared to today. The effect of these particles on aquatic organisms is relatively well mapped, but their effect on plants remains still poorly understood [1]. Plants are the key part of entire human population diet. Microplastics and nanoplastics are known to bind and concentrate harmful chemicals from the environment (POP, toxins, pesticides, PCB etc.), [2]. They increase stress too and especially in plants, they bind to the surface of root fibers [3]. It is estimated that there is such plastic pollution in European agriculture soil as in the North Pacific gyrus [4]. In this study, we have analyzed the effect of bacteria-sized particles on *Arabidopsis thaliana*, peas (*Pisum sativum* L.) and maize (*Zea mays* L.) in hydroponic cultivation which eliminates the influence of soil and soil microbiota.

The procedure with trifluoroacetic acid was used for the synthesis of PET microparticles (MPs), [5]. The result was particles with a reduction coefficient of 100x (500-125 μm to 7-3 μm). All the variants grew at 20 °C/18 °C day/night temperatures, under 16/8 h day/night cycle photoperiod with light sensitivity 150 μmol $mol^{-2}s^{-1}$ in liquid Murashige-Skoog (MS) medium, placed in shaker with 75 rpm. *Pisum sativum* and *Zea mays* grew in same conditions as mentioned above, with the difference of growing in pots without shaking and using Richter solution as medium.

Concentrations of MPs used in experiments with *A. thaliana* were 0 mg/l, 20 mg/l, 50 mg/l, 100 mg/l and 150 mg/l. It was believed, that lower amounts probably will not have effect on plants in medium. From all four variants used, the concentration of 150 mg/l seemed most damaging to the *Arabidopsis thaliana*. These plants showed significant loss of chlorophylls and showed symptoms of highly stressing environment. In general plants growing in environment with MPs grew significantly slower with ratio: higher concentrations of MPs = slower growth. For the plants of *Pisum sativum* and *Zea mays* were used concentrations 20 mg/l, where it seems it affected them by slight loss in chlorophylls, but the growth was not affected consistently. We believe that it is the interaction of MPs with mucilaginous sheath on roots that prevent efficient absorption of nutrients, but it needs another experiments. These results need to be verified using other methods (microscopy, SEM, transcriptomics etc.).

These results are interesting in the context of agricultural production and vertical farming, which may be farming of future. Maize and peas appear to be sensitive to very low concentrations of MPs in the environment (20 mg/l), which is bad news especially in Europe, North America and East Asia, where production of MPs is the highest on the world. Road transport generates up to 16 mg/m^2 MPs annually [6] - these particles continue to interact with plants, which may have unexpected consequences for agriculture in future.

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