Description for the General Public

Nanotechnology is a fast-growing field of science that uses the concept of miniaturization for solving chemical and biological problems. Nanoparticles (NP) are submicron size particles with less than 100 nm size, at least in one dimension, which are intensively used in energy, materials, computer chips, manufacturing, health care, medical diagnosis and consumer product industries. As per the National Science Foundation (NSF, USA) projection, the world market for nanotechnological products would account for about 3 trillion USD in 2020. Today, more than 1300 products incorporaing NPs are commercialy available. For instance, gold NPs are used as antibacterial agents in biocide coating, soap, toothpaste and shampoo, and is the most prevalent nanoparticle in over 25 consumer products. Silver (Ag) NPs are deployed in water purification, antifouling surfaces, and aseptic food packaging because of their antimicrobial potential. Medical applications of Ag NPs include wound dressings, surface sterilization of devices, implantations, masks, clothing, and bedding. ZnO NPs are in heavy use in personal care products such as sunscreens, cosmetics, textiles, paintings, and in industrial coatings, dye-sensitized solar cells, antibacterial agents, and optic and electronic materials. Copper oxide (CuO) NPs are used in gas sensing, optoelectronics, catalysis, solar cells, semiconductors, pigments and as fungicides. Titanium oxide (TiO_2) NPs are found in paints, coatings, plastics, papers, inks, medicines, pharmaceuticals, food products, cosmetics, and toothpaste.

NPs are released into the environment during their lifecycle as nanomaterial-containing wastes resulting in environmental pollution (**Nanopollution**). Although the presence of NPs affects largely the functioning of ecosystems, the exact impact is still unknown, as there is no technology available to detect the presence of NPs in the environment.

As plants are intimately connected to water and soil, the two major accumulation sites of NP, they are at the most risk. Basically, NPs are considered as **pollutants of unforeseen consequences reaching the plants in significant amounts**. Studies conducted so far in several model plant species and crops have demonstrated that the NPs affect plants' growth and development in a concentration dependent manner, depending also on the plant species and the physical properties of NPs. Upon interaction with NPs, disturbances of metabolic processes due to the formation of reactive oxygen species, damage to the structure and function of cell membranes, and a decrease in enzyme activities and DNA synthesis are observed in plants. In addition, clues emerging from the literature also suggests that plant secondary metabolism could be affected by the nanopollution. However, **the impact of NPs on plant secondary metabolism has so far not been studied in any of the plant species comprehensively**.

Plant secondary metabolism is vital for plants survival as they play indespensable roles in plants as protectants against herbivores, pathogenic microbes, as signals for plant symbiotic interactions with beneficial microorganisms, as allelopathic agents in natural habitats to protect against competitors, as physical and chemical barriers to abiotic stressors such as UV and as endogenous regulators of plant growth regulators. In addition to their roles in plant survival, many secondary metabolites are economically important as drugs, flavor and fragrances, dye and pigments, pesticides, and food additives. Importantly, many of the drugs sold today are simple synthetic modifications or copies of the naturally obtained substances. In spite of their importance to plants' survival and human well-being, only limited information is available in the literature in the context of nanopollution effect on plant secondary metabolism. **In *HyperNano*, we will investigate how NPs might affect plant secondary metabolism using *H. perforatum* as a model.** Executing HyperNano is a basic scientific priority to will fill the gap in the scientific literature and widen our current knowledge. Altogether, HyperNano will be of great interest to medicinal plant farmers, consumers, pharmaceutical industry, environmentalists and to the scientific community.