Organic farming is an new trend of agriculture applied for sustainable development and global human health, which include a set of natural agrotechniques. It prohibits the use of synthetic fertilizers, instead of that natural micronutrients addition, compost and other natural preparations. Low concentration of nutrients are most often delivered to plants by foliar application. One of them is soluble silica – the only mineral nutrient permissible for organic farming. It has been reported that silica causes systemic resistance to environmental factors in plants and leads to activation of photosynthesis, thus increasing the total physiological performance of plants: better growth, higher yield and better quality of fruits.

Silicon plays a pivotal role in plant's biotic stress responses by activation of defense-related metabolites, regulation of signaling pathways, and upregulation of protective genes. Silica fertilization has also positive effect on reducing plant damage by insects, mitigating of heavy metal toxicity, as well as salt and drought stresses. Unfortunately, the detailed mechanism of silica action under the field conditions is not recognized. Grapevine (*Vitis vinifera* L.) is one of the most important commercial crop growing worldwide for its fruit (fresh and dry), juice, oil and wine production. Viticulture has been very popular in recent years. Private vineyards many often are located within the cities, and this makes viticulture have to cope with ongoing climate changes, fluctuation of environmental factors and plant yield. One of the example of local vineyard is the "Wieliczka Vineyard", which was established in 2013 at the Wieliczka Foothills. Vineyard and winery have an ecological certificate and is based on organic and ecological viticulture.

In the current project we aim to evaluate the field foliar application of silica nanoparticles on the grapevines vigor, through the series of physiological, cellular and molecular analysis. First, we will thoroughly characterize the silica preparation, which is used for plant treatment in vineyard. Soil analysis and meteorological parameters enable us proper interpretation of the rest of the planned experiments. They include the following analysis: net photosynthesis rate, chlorophyll fluorescence imaging, analysis of stomatal conductance and transpiration rate. All these experiments will be performed in a field (vineyard) with the use of portable equipment. Next, we will perform analysis on cellular and molecular levels. For that purposes, we will use the light and electron transmission microscopy on mature leaves to check if silica nanoparticles interact with leaves surface or deeper – with organelles. In parallel, we will determine the set of biochemical analysis: measurements of total polyphenols, sugars, antioxidants in leaves and berries which are important for grapevine processing and final products (wine, jam, oil, raisins). To understand the molecular basis of silica nanoparticles action we will perform microarray analysis and real-time quantitative PCR for most up- and downregulated genes. Finally, the analysis will be complemented by safety assessment of silica based on genotoxicity tests.

Our project deals with the investigation of silica nanoparticles treatment on the growth and development of grapevines growing under field conditions in Wieliczka Vineyard. Field studies are extremely important from scientific and agricultural points of view, because they encompass comperhensive plant response to mixture of environmental factors. Successful achievements of the project will have immense importance of crops and other plants by increasing efficiency of their growth and yield, resistance to biotic stresses and enhancement of nutritional quality of grapes. Silica fertilization is one of the natural practice in organic, ecological farming, but mechanism of silica action has not been fully recognized yet. Organic farming plays an important role in environmental sustainability, crop improvement and global food security, thus in maintaining human health and well-being.