with a high capacity for lowering pH and releasing carboxylates from roots (e.g. genus *Lupinus*), which is a common strategy of plants to mobilize poorly available nutrients such as Fe, Mn and P in the rhizosphere, we could demonstrate that they were able to mobilize Ge. However, it seems that these species are not able to take up the mobilized Ge from soil solution.

Due to the chemical similarity between Si and Ge grass species, which accumulate Si in their shoots, are able to take up higher amounts of Ge than forbs. On the other hand, forbs which can release a high amount of organic acids from their roots and thus mobilize Ge in the soil, show only a limited capacity for Ge uptake, most probably because of the formation of soluble Ge-organic complexes. The mobilization of Ge seems to be restricted to the rhizosphere with its distinct pH and carboxylate gradients. Due to the higher reactivity of Ge in the soil, plant availability of Ge is lower compared to Si. This demonstrates that mobility of elements in the soil solution *per se* is not necessarily a good indicator for bioavailability of target elements in phytomining and phytoremediation.

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CALCIUM-DEPENDENT INDUCTION OF PLANT CELLS HEAT RESISTANCE BY HYDROGEN SULFIDE DONOR

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Hydrogen sulfide (H_2S) is currently regarded as an important signal mediator, along with reactive oxygen species (ROS) and nitric oxide (NO) (Hancock, 2016). An increase in the endogenous content of hydrogen sulfide in plant cells under action of stress factors of various nature have been shown (Jin et al., 2011; Shi et al., 2014). Data were also obtained on an increase in resistance of plants under the influence of hydrogen sulfide donors, the most popular of which a sodium hydrosulfide (NaHS) is (Lisjak et al., 2013). In some papers, results have been obtained that indicate the participation of ROS in transduction of hydrogen sulfide signal and H_2S-induced activation of antioxidant system (Wang, 2012; Kolupaev et al., 2017). It is known that the formation of signaling ROS is largely dependent on calcium homeostasis. This is due, in particular, to the direct and indirect influence of calcium on the activity of NADPH oxidase (Ogasawara et al., 2008). It can be assumed that the influence of hydrogen sulfide on the ROS formation and antioxidant activity is mediated by calcium ions. However, specific experimental data suggesting a possible causal relationship between changes in calcium homeostasis, activation of the antioxidant system and the development of plant cell resistance to hyperthermia under the action of exogenous hydrogen sulfide were absent at the time of our work. In connection with the above, the aim of this work was to elucidate the participation of calcium ions in the inducing of antioxidant enzymes and heat resistance of wheat coleoptile cells by the action of the hydrogen sulfide donor.

Coleoptiles, separated from 4-day-old wheat (*Triticum aestivum* L.) seedlings of variety Dosconala, were incubated at 2% sterile sucrose with penicillin addition. 100 μM NaHS was added to the incubation medium of coleoptiles of experimental variants, which were incubated there for 24 hours, then the activity of superoxide dismutase (SOD), catalase and guaiacol peroxidase (GPO) was determined in coleoptiles. A part

of coleoptiles' segments was subjected to a damaging heating at 46°C for 10 min. In some variants, 2 hours before NaHS was added, calcium antagonists were added to the coleoptiles' incubation medium: an extracellular calcium chelator EGTA (50 μM) and an inhibitor of phospholipase-C-dependent inositol-1,4,5-triphosphate (IP_3) formation neomycin (40 μM).

After 24 hours of incubation of coleoptiles in medium with the hydrogen sulfide donor, an increase in the activity of SOD, catalase and GPO and an increase in the resistance of coleoptiles to damaging heating were noted. These effects were almost completely suppressed in the presence of EGTA and neomycin. It can be assumed that in plant cells under the influence of exogenous hydrogen sulfide, there is an increase in the intake of calcium into cytosol both from extracellular space (a process that is inhibited by EGTA) and from intracellular compartments (a process dependent on IP_3 and suppressed by neomycin). The signal comprising changes in calcium and ROS content in cells induces an antioxidant system of cells, which can be important for the development of their heat resistance. It is quite natural that the antioxidant system is not the only protective system that was induced by exogenous hydrogen sulfide in plant cells. To assess the contribution of various protective systems to the realization of the effect of inducing resistance of plant objects to stressors by hydrogen sulfide, special studies are needed.

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ANALYSES OF SOIL MICROBIAL COMMUNITIES AND ESTIMATION OF RHIZOSPHERE INTERACTIONS

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Soil is a key factor for ecosystem development and it contributes to determination of the plant cover. Microorganisms play essential role in the soil functions and ecosystem services. In this contribution we review of methods for assessment of soil microbial communities and their metabolic characteristics. Special focus is given to methods of analytical chemistry, especially analysis of phospholipid fatty acids (PLFA). For illustration results of a few studies involving plant-microbe relations are presented such as phytoremediation with second generation biofuel crops, reclamation of post-mining sites or biotope valuation-soil microbe characteristics.

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Арапетьян Е.

ВИКОРИСТАННЯ РІДКОГО АЗОТУ ДЛЯ ЗБЕРІГАННЯ РОСЛИННОГО МАТЕРІАЛУ

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Arapetyan E. USING of LIQUID NITROGEN FOR PRESERVATION PLANT MATERIAL. Cryopreservation is the modern approach to long-term storage of plant material with the preservation of its biological characteristics. Cryopreservation implies storage of