

1. State the objectives of the project

Aim of work – determination of the effect of the soil drought on changes in the effectiveness of the aluminium resistance mechanism, consisting of excretion of malate acid from root cells, using near isogenic lines of wheat – Al-tolerant and Al-sensitive.

2. Research to be carried out

Research carried out in proposed project will be focused on understanding the reaction of plants on drought stress and aluminium toxicity on soil media. Plant material will be near isogenic lines of wheat with different aluminium tolerance (line tolerant – ET8 and sensitive – ES8). Soil material will be consisted of the soil with high concentration of aluminium (acid soil) and with low concentration of aluminium (limed soil). The plant response and the efficiency of the ET8 line resistance mechanism to the aluminum toxicity under drought conditions will be evaluated by:

- Analysis of photosynthetic apparatus including photosynthesis rate, chlorophyll content and fluorescence;
- Comparison of root system of both lines, morphology and distribution of roots with depth;
- Determination of efficiency of water and mineral nutrients uptake by roots;
- Determination of efficiency of aluminium tolerance mechanisms of the ET8 according to different soil moisture by evaluation of malate concentration in rhizosphere soil.

3. Present reasons for choosing the research topic

The main reason for carried out this project is to understand the plant response to simultaneous drought stress and aluminium toxicity in soil. In research papers we can find only information about plant reaction on these stresses in hydroponic cultures where soil drought is replaced by osmotic stress induced by polyethylene glycol. However, growth condition in hydroponic cultures differ significantly from those we can observed in soil media. The main factors that cannot be included in the studies in hydroponic cultures, and which are extremely important in the assessment of plant responses to drought and possible accompanied stresses:

- Soil penetration resistance – usually increasing with decreasing soil moisture and resulting in inhibition of root growth;
- The availability of water for plants changing with the depth and porosity of the soil and rooting depth;
- The availability of nutrients which depends on soil moisture and their mobility in the soil;
- Concentration of aluminium, which its concentration increases in the soil solution with decreasing soil moisture.

Understanding of the response mechanism of plant with different aluminium tolerance is necessary for taking measures of mitigation to climate change. In particular, it goes from predicted increasing occurrence of drought stress and natural process of soil acidification. Soil acidification occurs more rapidly as a result of the intensification of agriculture and leaching process, which have an influence on increasing concentration of toxic aluminium ions in soil, and thereby increasing the risks for both the environment and human health. Plant response to aluminium toxicity may be difficult or even impossible to predict when accompanied by another stress factor e.g. drought stress. On the one hand, drought stress limits uptake the water and generally stimulates root growth. On the other hand, if drought occurs in acid soils, the toxic effects of aluminium ions on the roots will be enhanced by increasing aluminium concentration in the soil solution.

An innovative aspect of the proposed project is to understand the impact of simultaneous drought stress and aluminum toxicity on the growth and functioning of the near isogenic wheat lines in the same and precise controlled experimental conditions.

The expected result of the study will be determination of the effectiveness of the mechanism of plant resistance to Al^{3+} (secretion of malate) in more frequent occurring droughts, and progressive process of soil acidification.