Zinc is a vital element for all living organisms, being essential for their growth and development. In humans, zinc is particularly crucial for proper immune system function. A deficiency in zinc can compromise the immune response, making individuals more susceptible to infections and illnesses. Plants serve as the primary source of this fundamental nutrient in our diets. Therefore, enhancing zinc levels in the edible parts of plants is of significant importance. Understanding how plants manage zinc is pivotal for improving nutritional quality of crops, especially in regions with insufficient zinc levels in soil.

Our research focuses on the model plant tobacco (*Nicotiana tabacum* L.). Although this plant is not edible, its metal transport is well studied, and interesting since it has relatively large ratio of zinc that goes to shoot, compared to other plants (it has increased root-to-shoot transport). Studying tobacco may help understand processes that could be further explored in other crops. So far, in tobacco we identified and studied a function of zinc transporters like NtZIP4b, which plays a significant role in zinc distribution within plants. In our research we investigate how plants absorb zinc and distribute it between roots and shoots, primarily using a liquid growth medium (hydroponic) that uniformly supplies zinc to the entire root system.

Recently, we explored a growth medium that not only allows control of its composition but also allows for uneven nutrient distribution in a growth pot. This medium, known as transparent soil, comprises gel beads supplying nutrients and water to plants, simulating natural soil conditions. In the study transparent soil with zinc was layered on top of a layer without zinc. Surprisingly, when tobacco plants were grown in this setup (with uneven zinc levels), roots in low-zinc areas didn't have signs specific for zinc deficiency! Instead, it seemed like they were obtaining sufficient zinc amounts from other parts of the plant. This suggests that the stream of zinc going to the shoot (where in many crops edible parts are found) might be partially redirected to the roots that lack zinc at the time. The mechanism behind this phenomenon remains unknown.

Our project aims to understand how zinc travels between roots with access to zinc and those without. We hypothesize that this movement initiates in (1) roots growing in zinc-sufficient medium, where most of zinc is loaded into the xylem (a plant tissue conducting water to the shoot) which we called **zinc source** sites. Subsequently, zinc should be (2) transported upwards (with the water stream) in a **zinc conduit**, followed by (3) uptake from the water stream (xylem) and loading into the phloem (a plant tissue conducting sugar from shoots to roots) in zinc parts we named **relocation sites**. Finally, (4) zinc would be delivered to zinc-deficient, lateral roots functioning as **zinc sinks**. We further assumed that specific kind of proteins - zinc transporters operate in zinc source, zinc relocation, and zinc sink sites, facilitating loading and unloading of zinc to promote effective zinc transfer between plant tissues and being major part of the mechanisms of the zinc distribution between lateral roots growing in medium with different zinc levels.

The first part of the project is to identify zinc source, zinc conduit, zinc relocation, and zinc sink sites in roots, where the zinc distribution mechanism occurs through the analysis of zinc concentration and zinc distribution. Next, using molecular biology techniques, we aim to identify both new (unknown) and known zinc transporters participating in the process of zinc distribution between lateral roots. We also intend to characterize the basic and physiological functions of unknown zinc transporters. Finally, we suggest that certain cellular adjustments may occur in zinc source, zinc relocation, and zinc sink sites, facilitating zinc transport, possibly involving an increase in cell surface area facing zinc transport sites.

Ultimately, our objective is to uncover the secrets of how plants share zinc between different root parts. Additionally, we will learn how much zinc, in such situations, does not reach the shoot. The results of the project could enhance our understanding of plant zinc homeostasis and help us develop new methods for efficient plant fertilization (with zinc), potentially influencing zinc level in edible parts of crops and, in the long run, could help fight with zinc malnutrition in people.