The role of acyl-CoA:lysophosphatidylethanolamine acyltransferases (LPEATs) in plants

Plant growth regulators are factors which non-trophically (i.e. unrelated to the access of nutrients) regulate plant growth and development. As plant growth regulators have been considered primarily low molecular weight compounds such as auxins, cytokines, gibberellins or abscisic acid so far. Our studies published in June 2017 in the prestigious scientific journal Plant Physiology, suggest, however, that certain proteins, namely acyl-CoA:lysophosphatidylethanolamine aryltransferases (LPEATs), may also be involved in plant growth regulation. These studies, which have been conducted on a model plant *Arabidopsis thaliana*, have proven that lowering the LPEAT activity (through silencing its encoding genes) very strongly reduces the growth of the mutants. Simultaneously, increasing the activity of LPEATs in *A. thaliana* mutants (with overexpression of genes responsible for their synthesis) triggers those mutants' overgrowth in comparison to control plants.

Inhibition of plant growth is often observed with certain genes being made inoperative. What is rarely heard of is growth inhibition which happens after lowering a gene's activity and growth stimulation after its activity has been increased. When this situation occurs, the activity of such enzymes can be assigned as a 'plant growth regulator', as is the case with LPEATs.

The aforementioned pioneering research has led to highly surprising results, as no one had previously assumed that the activity of such enzymes could regulate plant growth. Other studies in which the activity of various acyl:CoA-lysophospholipid acyltransferases was lowered or increased, did not show a differences in mutants' growth and development rate compared to control plants.

Acyl-CoA-lysophospholipid acyltransferases (LPLATs) are widespread enzymes found in animals, plants and microorganisms. They utilize lysophospholipids and acyl-CoA to synthesize corresponding phospholipids. It is believed that they also take part in phospholipids' fatty acid remodelling. Essentially they are divided into three classes: LPAATs (acyl-CoA:lysophosphatidic acid acyltransferases), LPCATs (acyl-CoA:lysophosphatidylcholine acyltransferases) and LPEATs (acyl-CoA:lysophosphatidylethanolamine acyltransferases), depending on the type of acceptor used preferentially by the enzyme. The LPEAT-type of acyltransferases have been the subject of our prior research and will be the main focus of present project.

Current project will aim to verify if observations made while studying *Arabidopsis thaliana* mutants exhibiting lowered or increased LPEAT-type acyltransferase activities, are universal – if they can be repeated in other species. The second equally important aim will be explaining the mechanism behind this regulation.

Right now we reckon that the regulation of plant growth connected to the activity of LPEAT-type enzymes may at least partly occur through regulation of the autophagy level. Autophagy is a catabolic process in which a plant cell digests dead or damaged parts of itself. In the preliminary studies we have observed a certain correlation between LPEAT activity and the intensity of this process.

In the presented project we are planning to investigate also the impact of downgraded or increased activity of LPEAT-type enzymes on plant's survival in stress conditions (drought, salinity, extreme temperatures).

Besides research concerning autophagy, throughout all project objectives we also plan to thoroughly examine lipid content and composition of all plants cultivated both in standard and stress conditions; LPEAT activity may regulate the levels of some lipid classes, what may in turn affect other processes connected to plant development.

The knowledge of the mechanisms of plant growth regulation by LPEAT may in the future result in the use of this knowledge to create new improved varieties of crop plants, e.g. more tolerant to stress conditions.