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SGGW scientists prepare plants for drought

Drought in Poland is a huge problem, which is why scientists are researching to improve plants' defence mechanism against it. Dr Marta Gietler from the Department of Biochemistry and Microbiology of the Institute of Biology at the Warsaw University of Life Sciences told us what

stage the research is at.

Stress in plants and readiness to defend

Drought in Poland is a growing problem every year. Nearly snowless winters and little rainfall in the other seasons cause huge water shortages. Soils dry out alarmingly, limiting plant germination and reducing crop yields. If the rain does not come regularly at the correct times, agriculture faces a serious problem – a reduction in crop yields, which also affects access to food. And thus affects the consumer.
Scientists from the Warsaw University of Life Sciences are researching to find a way to combat drought. More specifically, a way to protect plants from it.

Plants experience different types of stress – abiotic stress (high temperature, drought, inadequate salinity, wind, frost) and biotic stress (bacteria, viruses, fungi, insects, animals and even humans). These are factors that can negatively affect the condition of the plant. Prolonged exposure to these factors can result in a reaction in which the plant adapts to the new conditions and acquires resistance, but can also lead to death.

Each plant has its own defence system, which the SGGW researchers decided to strengthen by finding a suitable method.

ABA, H2O2 and potatoes

– My current work, with Dr Justyna Fidler and Dr Małgorzata Nykiel from the Department of Biochemistry and Microbiology of the Institute of Biology of the Warsaw University of Life Sciences (SGGW) and Dr hab. Dominika Boguszewska-Mańkowska from the Institute of Plant Breeding and Acclimatisation – National Research Institute, the potato and the response of its defence system to drought, temperature and a combination of these stresses," says ***Dr. Marta Gietler*** *from the Department of Biochemistry and Microbiology of the Institute of Biology at the Warsaw University of Life Sciences. – I am primarily interested in proteomic research, the study of proteins that are key in a plant's response to stress. A very interesting discovery came out of the research. It turns out that in the case of the potato, the response is closely linked to the chloroplasts – the organelles that make photosynthesis possible all the time. Then, when the potato (the green part) carries out photosynthesis, it produces sugars, which are then transported to the tubers. And this is how the corresponding yield is produced. While in the case of the wheat study, we found that, as a result of stress, the plant is primarily concerned with producing more energy to have the strength to fight, the potato copes differently. The potato focuses on protecting the chloroplasts so that sugar is synthesised all the time, which will then be stored in the part of the plant that we call the potato (correctly, the tuber) in the form of starch. A whole system of*

guardian proteins called chaperones is activated in this process, which protect the chloroplasts. This ensures that photosynthesis is carried out with the maximum efficiency the potato can afford.

Scientists tested abscisic acid (ABA), a synthetic plant hormone that regulates stress to protect the chloroplasts. The hormone was added to the nutrient solution on which the plants grew. This proved to make the potatoes better able to withstand drought stress. Unfortunately, the downside of this product is the high price, which is not a good solution for agriculture, although possible.

Another product that the researchers tested was hydrogen peroxide (H2O2). It too proved to be a good solution and, on top of that, affordable. In this case, the product is more accessible and could be applied to large farmland areas.

Both ABA and H2O2 are natural mediators of the stress response in plants. Exposure of the potato to these mediators means that later, once the actual stress has occurred, the potato can rapidly activate immune mechanisms. A faster response is associated with better stress tolerance and a greater chance of survival.

– We are also researching the use of other substances," says Dr M. Gietler. – It is important to remember that the right choice is important, because what is safe for a plant is not necessarily safe for humans. And since our research involves cultivated plants, we pay particular attention to the substances added. At the moment, we have promising results with potatoes, ABA hormone and oxidised water. But the research is still ongoing.

When to react?

The test substances should be applied at the right time, when we know that adverse weather conditions are approaching. And importantly, it does not have to be at the seedling stage, the stage of plant development that follows seed germination or the emergence of the embryonic root (sprout). An intra-root application of ABA or H2O2 will improve the plant's response to stress. This enables it to survive unfavourable conditions.

– The plant's response is faster and more intense, closes the stomata faster, and does not lose water. Of course, the plant has a certain plasticity within which it functions. When a limit is crossed, i.e., a very intense and prolonged stress occurs, it will eventually die. We at SGGW are working on improving the plant's response to drought under significantly increased stress conditions, but not extreme ones. Our research is up-and-coming, important for maintaining a satisfactory potato yield," adds Dr Marta Gietler from SGGW.

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Metryczka

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