International online workshop
SOI and SIGA 2021
"The colours and antioxidants of fruits and vegetables: what genes and horticultural practices can do"

Effect of glutamic acid on lettuce under different abiotic stress conditions.

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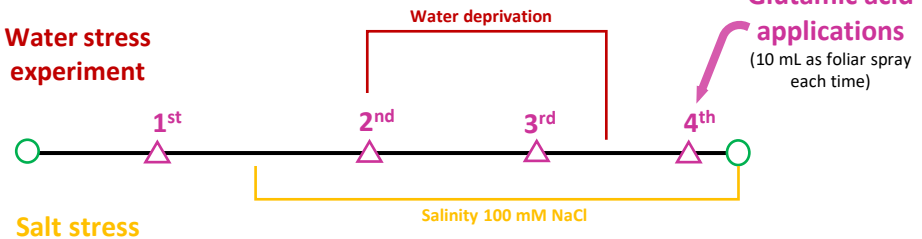
Introduction

Leafy vegetables are a rich source of bioactive phytochemicals that play an important role in the maintenance of human health and reduction of the risk to develop chronic diseases.

The protective effect gained by the regular consumption of vegetables is generally attributed to their **antioxidant** constituents able to reduce oxidative damage by neutralizing the activities of free-radicals. Many of these compounds are plant secondary metabolites. It is known that they play a major role in the adaptation of plants to the environment and they often accumulate in overcoming stress conditions as part of the plant defence system. The application of **biostimulant** products has beneficial effects on plants, by fortifying the antioxidant machinery and enhancing the tolerance under various abiotic stresses. The application of amino acids as biostimulants is a strategy that can be used in horticultural crops for counteracting the negative effects induced by environmental stresses. The effects of salinity and water stress, in combination with the application of a glutamic acid treatment were evaluated in lettuce plants in two separate experiment.

Materials and Methods

Lactuca sativa L. var. Longifolia



- **Chlorophyll *a* fluorescence**: to assess the plant physiological status
- **ABA, proline**: as biochemical markers of plant responses to the stress
- expression of some **genes** involved in ROS scavenging and ascorbate-glutathione cycle

Results

Salinity induced a significant increase in chlorophyll content (Fig. 1), an important quality parameter of leafy vegetables. At the molecular level, the expression of the genes involved in the antioxidant defence system decreased in plants subjected to high salinity (Fig. 2) and water deprivation (Fig. 3). Glutamic acid treatment induced a peak in *LsSOD* expression after 6 hours in plants grown under constant water supply and in plants grown under salt imposition. This might be indicative of a potential main role of SOD to alleviate oxidative damage due to salt exposition. The photosynthetic apparatus was not damaged by the water deprivation in a permanent way (Fig.4).

Salt stress

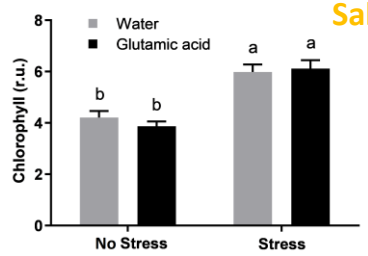


Fig. 1 Chlorophyll content in lettuce leaves

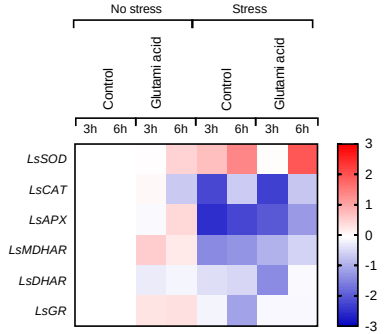


Fig 2. Heatmap showing the log2-fold change in gene expression

Water stress

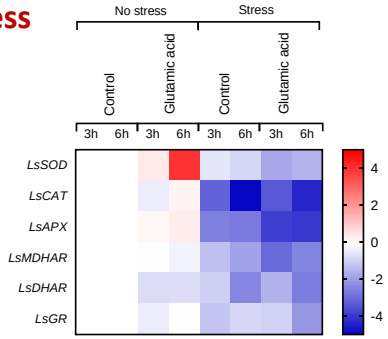


Fig 3. Heatmap showing the log2-fold change in gene expression

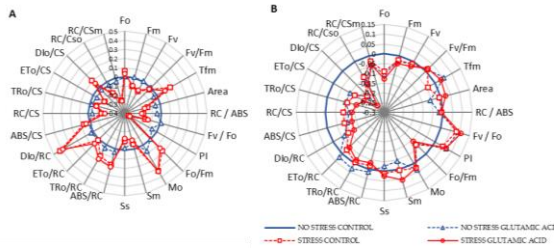


Fig. 4 Chlorophyll *a* fluorescence parameters of lettuce plants (A: water stress B:after re-watering)

Conclusions

Romaine lettuce was confirmed to be moderately tolerant to the experimental conditions tested based on the less severe stress responses activated both at physiological and molecular levels.

The lack of a strong activation of the enzymatic scavenging systems may also indicate a good content of antioxidant compounds naturally occurring in lettuce leaves.

Future studies will be focused on the clarification of SOD role under non-stressful conditions and its link to glutamic acid metabolism.

Franzoni, G., Cocetta, G., & Ferrante, A. (2021). Effect of glutamic acid foliar applications on lettuce under water stress. *Physiology and Molecular Biology of Plants*, *27*(5), 1059-1072.