LEA Proteins: Their Role in Abiotic Stress Resistance and Insights into The Future

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INTRODUCTION

Plants are often exposed to adverse conditions, which might cause what is called **abiotic stress**. It usually has a negative impact on their performance so in order to withstand such situations, plants have developed different mechanisms of tolerance. **LEA (Late Embryogenesis Abundant) proteins**, found in all types of plants, are thought to have a main role in abiotic stress tolerance, but their molecular mechanisms are still unknown. This project reviews some research about the nature of such proteins and tries to cast some light on their possible biotechnological uses to face the impact of climate change and meet future demands.

CLASSIFICATION

All LEA proteins are **hydrophilic** and contain a high content of **glycine residues**.

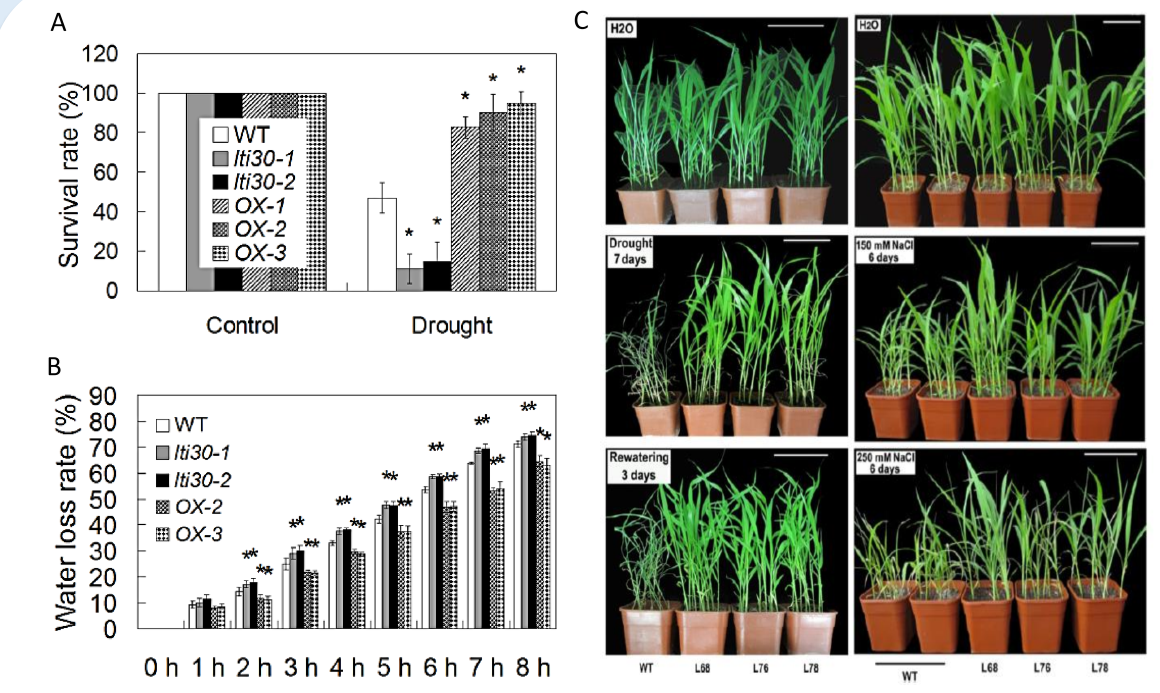
Classification based on shared motifs:

- Group 1
- Group 2
- Group 3A/B
- Group 4A/B
- Group 5A/B/C
- Group 6
- Group 7

FUNCTIONS

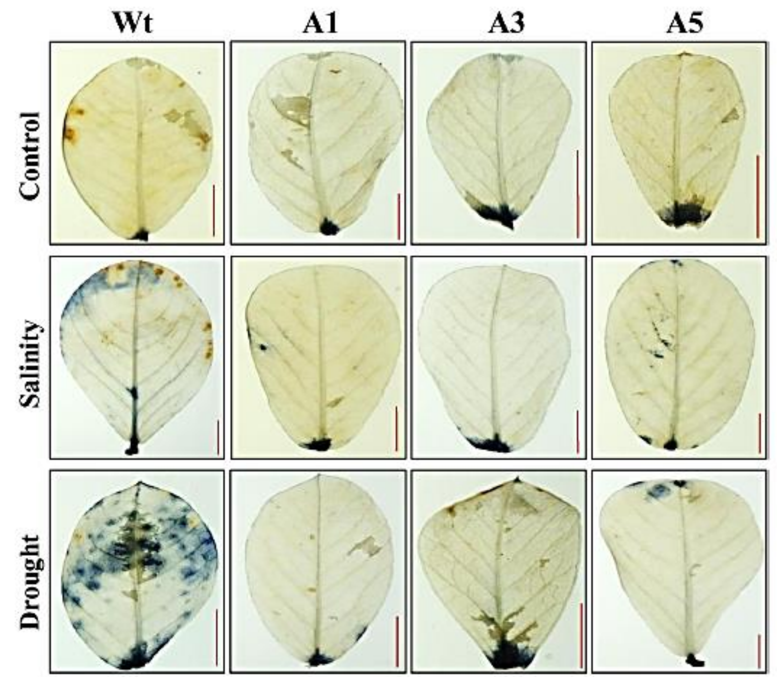
- Protein protection
- Membrane integrity maintenance
- Antioxidant function
- Reinforce glassy states
- Hydration buffer
- Chaperone activity

RESULTS



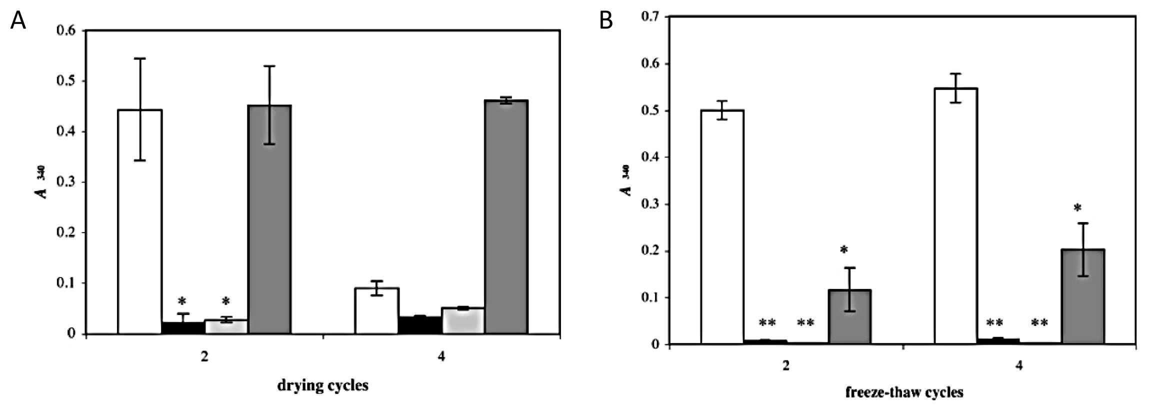
(A) Recovering for 4 days after 21 days of drought, knockout mutants (*lti30*) and WT show a lower survival rate than overexpressing mutants (*OX*) of *AtLTI30*. **(B)** Relative leaf water loss in different genotypes. **(C)** Growth of WT and transgenic lines under drought (left) and salinity (right) stress.[1,2]

DROUGHT TOLERANCE



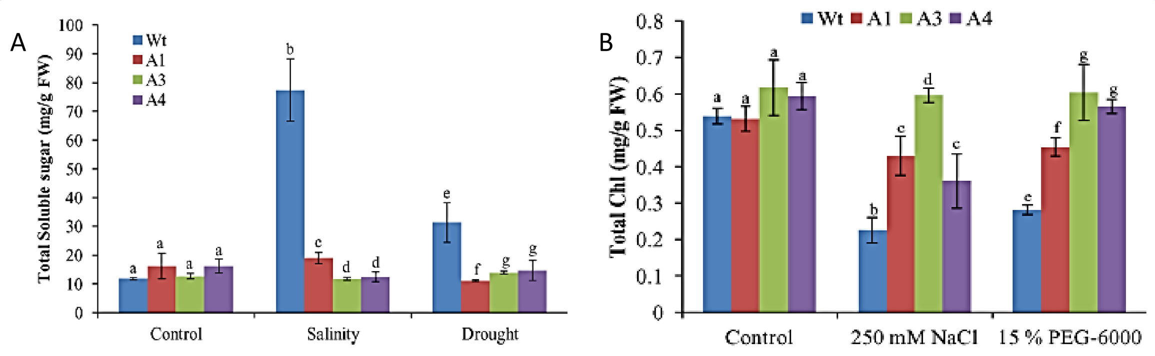
In vivo localization of ROS in leaves of Wt and transgenic lines of *SbASR-1* enduring salinity stress or dehydration. Mutants show almost an inexistent ROS accumulation.[3]

ANTIOXIDANT EFFECT



CS aggregation in presence and absence of LEA proteins (black and light grey bars).[4]

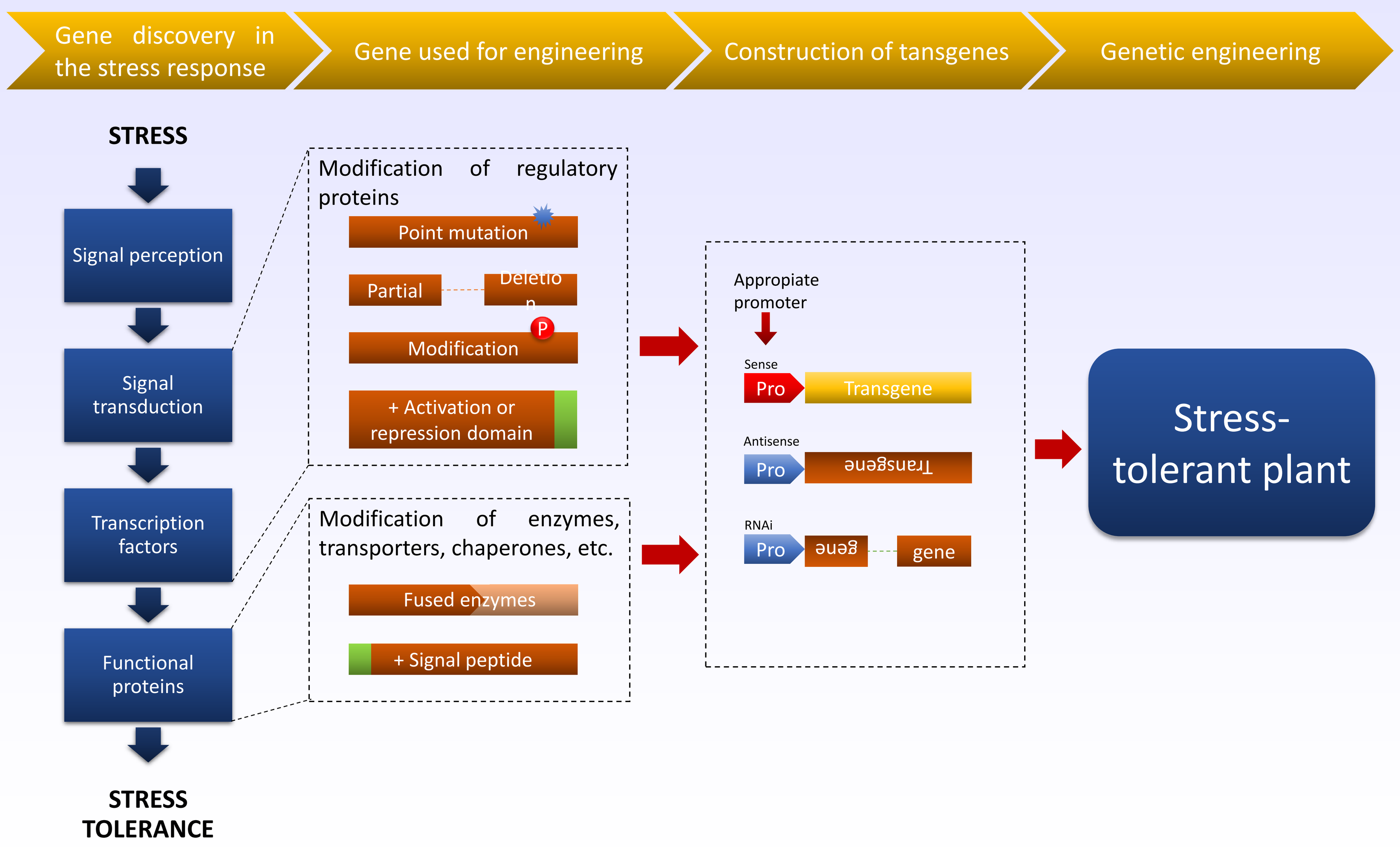
ANTIAGREGGATION



(A) Content of soluble sugar in WT and mutant plants. **(B)** Content of chlorophyll in leaf discs of WT and mutants under salinity stress.[3]

SALINITY TOLERANCE

BIOTECHNOLOGICAL APPLICATIONS



Adapted from Umezawa et al. (2006). Engineering drought tolerance in plants : discovering and tailoring genes to unlock the future.

In light of the results here shown and many more available for public consultation, it is safe to say that using LEA proteins in genetic improvement of plants, and more specific, in stress tolerance would be advisable. Despite further investigation still being needed, the large quantity of positive results in both laboratory and field trials, suggest many possible applications, including:

- **Developing drought-resistant plants**, suitable for human consumption. This way, it would be possible to plant them in lands that are becoming less arable, contributing to food security and sustainability.
- Creating plants with a magnified response to a specific factor, such as ABA, which might **enhance their growth and performance**. This would be beneficial for wild biodiversity.
- Taking advantage of their antioxidant effect, **oxidative stress-resistant plants could be developed** and, therefore, be able to grow properly in flooded areas, where the lack of oxygen might cause the production of ROS.

CONCLUSION AND FUTURE PROSPECTS

LEA proteins have a vital role in stress tolerance, widely confirmed by many researchers. All of the positive results obtained by such researchers give credit to this affirmation.

Their use in agriculture and other fields would be beneficial, not just for improving the quality or production but for facing climate change and upcoming adversities.

However, transgenic products are not very socially accepted and a lot of negative propaganda surrounds them. **Efforts from politicians and the scientific community are necessary** to counteract this perception.

REFERENCES

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4. Goyal, K., Walton, L. J., & Tunnacliffe, A. (2005). *LEA proteins prevent protein aggregation due to water stress*. The Biochemical Journal, 388(Pt 1), 151–7. http://doi.org/10.1042/BJ20041931