ABSTRACT

Abiotic stress, and more specifically salinity and drought, are environmental
problems that have huge impact on global food production, especially in semi-arid
areas such as the Mediterranean countries including the Valencia region. Little
progress has been made in the development of crops tolerant to drought and salinity.
The problem has two aspects: tolerance to toxic cations such as sodium and tolerance
to osmotic stress.

In order to approach the first one we have screened tagged-mutant collections
in the model plant Arabidopsis thaliana to identify lines tolerant to toxic cations. We
have used as toxic cation norspermidine, a non-physiological polyamine that only acts
as a toxic cation because it has no osmotic effects at the concentrations employed. This
polycation enters the cell through unidentified system strongly dependent on the
electrical potential of the plasma membrane. As this biophysical parameter is
determined by the relative activities of the H+-ATPase pump and secondary ion
transport of K+ and anions, norspermidine tolerant mutants could allow us to identify
regulators of these transporters. We have screened 110,000 mutant lines (around
700,000 seeds) from 3 transcriptional activation mutant collections and 2 loss of
function mutant collections in Arabidopsis thaliana. In this way, we have obtained
numerous confirmed mutants tolerant to this polycation, with 2 - 6 fold germination
percentage than the control line.

In order to approach tolerance to osmotic stress, we have expressed the HSRI
gene from Candida tropicalis in the model plant Arabidopsis thaliana to evaluate its
effect on plant drought tolerance. This gene was isolated from a gene library of
Candida tropicalis strain NCYC2512 by screening for the identification of halotolerant
genes in the yeast Saccharomyces cerevisiae. Arabidopsis transgenic plants expressing
CtHSRI from its own promoter exhibited tolerance to osmotic stress in two different
assays: seed germination inhibited by NaCl and manitol and drought tolerance of
adult plants in the greenhouse. Differences in osmotic potential were observed under
normal growth conditions in the transgenic lines and we measure an increase in
proline content between 1.4 and 1.8 fold, compared to control plants. Transcriptomic
analysis indicated that HSR1 induces multiple transcription factors involved in
response to stress. Hormone analysis detected an increase of jasmonic acid, hormone
involved in biotic stress tolerance.

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