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Comparison of salinity and drought stress effects on abscisic acid metabolites activity of cytokinin oxidase/dehydrogenase and chlorophyll levels in radish audtabacco

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Summary. Stronger negative impact of salinity (100 mM NaCl for 4 days) on radish plants in comparison with tobacco ones, correlated with more profound decrease of bioactive cytokinins and higher elevation of activity of the main cytokinin degrading enzyme cytokinin oxidase/dehydrogenase and abscisic acid in the former species.

Key words: abscisic acid, cytokinin, radish, salinity, tobacco.

1. Introduction

Plant hormones play an important role in plant response to abiotic stresses, by both stimulation of defence pathways and regulation of plant growth and development. The key hormone in the response to stresses associated with dehydration is abscisic acid (ABA). Its levels were followed during the response to salinity or drought in two species differing in their stress tolerance – radish and tobacco. As cytokinins (CKs) play an important role in regulation of growth and delay of senescence, their level was determined as well.

Regulation of plant hormone (ABA and CK) pool during the response to salinity or drought stress.

2. Material and methods

Radish (*Raphanus sativus* L. cv. Rampouch) and tobacco (*Nicotiana tabacum* L. Samsun) plants were cultivated in soil in a growth chamber (SANYO MLR 350H) at 16/8 h light/dark regime, 130 $\mu mol \cdot m^{-2} \cdot s^{-1}$, at 23°C. Plants at the stage of 4 weeks (radish) and 5 weeks (tobacco) were subjected to salinity stress (100 mM NaCl) or drought stress (withdrawal of watering) for 4 days.

Phytohormones were determined in leaves of control and stressed plants according to Dobrev and Kaminek (2002). ABA levels were quantified using two-dimensional HPLC according to Dobrev et al. (2005). Content of 24 CK metabolites was estimated by LC/MS (Dobrev et al. 2002). The cytokinin oxidase/dehydrogenase (CKX) activity was determined by a modified radioisotope method described by Motyka et al. (2003). Chlorophyll a and b, β-carotene and xanthophyll cycle pigments were analysed by HPLC.

3. Results and discussion

Salinity stress imposed significantly milder effect on tobacco plants than on the radish ones, which became wilty. Tobacco was also less affected by the four-day drought (RWC decrease by ca 11%), while radish, as a spring species, was more severely stressed (RWC decrease by ca 19%). In radish, chlorophyll a level exhibited mild decrease

(by ca 10%) in salinity and more profound in drought (by ca 20%). Chlorophyll b content was significantly lower, but followed the same trend. In tobacco, salinity caused stronger suppression of chlorophyll a levels than drought. The amount of β-carotene and xanthophyll cycle pigments followed similar trends as chlorophyll a in both species.

Higher sensitivity of radish to applied abiotic stresses was also reflected by the changes in the ABA content. Salinity and drought caused in radish 2.9 and 4.7 – fold ABA increase, respectively. In tobacco, the effect of salinity was very mild (1.2 fold increase), while drought imposed 2.4 – fold ABA increase. The basal level of ABA was, however, much higher in tobacco, so in spite of relatively lower elevation, ABA content in stressed tobacco plants was more than three times higher than in radish.

Salinity imposed in radish leaves significant decrease in the level of bioactive CKs (by ca 25%), the effect of drought was much stronger (bioactive CK decrease by ca 73%). Similar trend was observed in case of CK phosphates, the immediate biosynthetic CK precursors. CK deactivation products, CK N-glucosides, negatively correlated with bioactive CKs. Mild, but significant, increase was observed in salt stress, while profound elevation (by ca 100%) was found in drought. The level of reversible glucoconjugates, CK O-glucosides, was relatively low, being higher in salinity than in drought. The same trend was observed in case of *cis*-zeatin derivatives.

Higher drought tolerance of tobacco plants correlated with a milder decrease of bioactive CKs under this stress conditions than in salinity. In case of CK phosphates, significant reduction was observed in both stresses. No significant change was found in CK N-glucosides. CK O-glucosides elevated under salt stress, but decreased in drought, which might indicate that CK deactivation was suppressed under the latter conditions.

When the activity of the main CK degrading enzyme, CKX, was monitored, higher elevation was found in drought than in salinity in radish. Response to both stresses was in tobacco associated with mild CKX decrease.

The achieved results indicate that higher stress sensitivity of radish was associated with more profound decrease of bioactive CKs, accompanied with stimulation of their degradation. More drought tolerant species, tobacco, exhibited also decrease in bioactive CKs, however, relatively low CK degradation by CKX as well as low CK deactivation by CK O-glucosylation seems to indicate that mild stresses are associated with tendency to maintain the level of bioactive CKs, at least during early stress period. Both ABA and CKs seem to play an important role in abiotic stress response, being tightly regulated in dependence on stress strength.

Acknowledgements

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