ABSTRACT

Cytokinins (CKs) are one of the most important group of phytohormones influencing many processes throughout the whole plant.

As many processes are regulated both by the light and phytohormones, the first part of this work has been focused on evaluation of diurnal rhytmicity in levels of cytokinins and other cooperating hormones like auxin (indol-3-acetic acid, IAA), abscisic acid (ABA) and polyamines (PA). The changes in activity of selected enzymes participating in metabolism of the above mentioned phytohormones were followed as well. Diurnal variation of phytohormones was tested in tobacco leaves (*Nicotiana tabacum* L. cv. Wisconsin 38) grown under a 16/8 h (light/dark) period.

The main peak of the physiologically active forms of CKs, found after the middle of the light period, coincided well with the maximum of IAA and PA levels and with activity of the corresponding enzymes. The achieved data indicate that metabolism of CKs, IAA and PAs is tightly regulated by the circadian clock.

The other part of the study has been focused on changes in the contents of CKs, IAA and ABA in transgenic tobacco plants with altered cytokinin metabolism, achieved via the over-expression of particular enzymes participating in CK metabolism (biosynthesis, degradation and reversible conjugation). As CKs are known to be involved in plastid differentiation and function as well as part of CK biosynthetic pathway is localized in plastids, the impact of modulation of CK metabolism in cytoplasm on CK levels in the whole leaves and isolated chloroplasts was compared. The achieved results suggest that plant hormone compartmentation plays an important role in hormone homeostasis and that the chloroplasts are relatively autonomous organelles with respect to regulation of CK metabolism.

Finally, we studied the impact of water deficit progression on CK, IAA and ABA levels in upper, middle and lower leaves and roots of wild type tobacco plants and two transformants over-expressing *trans*-zeatin *O*-glucosyltransferase gene (*ZOG1*) either under constitutive *35S* or senescence-inducible *SAG12* promoters. During drought stress, ABA content strongly increased, especially in upper leaves. A delay in ABA elevation was observed in plants with constitutive over-expression of *ZOG1,* which indicates that high CK levels might postpone stress sensing. As drought progressed, content of bioactive CKs in leaves gradually decreased, being maintained longer in the upper leaves of all tested genotypes. Establishment of active CK gradient in the favour of upper leaves suggests preferential protection of these leaves. During drought, significant accumulation both of CKs and IAA occured in roots, indicating the role of these hormones in root response to severe drought, which involves the stimulation of primary root growth and inhibition of lateral root initiation and formation.