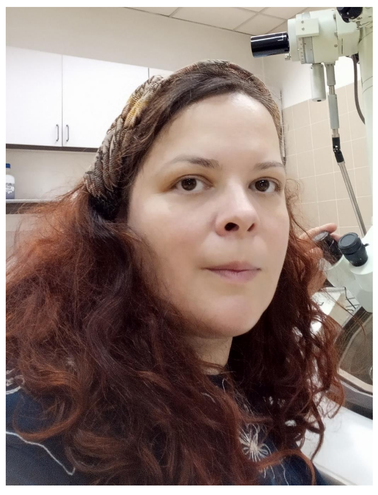
Adél SÓTI[1], Roumaissa OUNOKI[1],Annamária KÓSA[1], Beata MYSLIWA-KURDZIEL[2], Éva SÁRVÁRI [1], Katalin SOLYMOSI[1]



Sodium ions have the strongest negative impact on the chlorophyll synthesis and greening of wheat seedlings

[1]ELTE Eötvös Lóránd University, Budapest, Hungary; [2]Jagiellonian University, Krakow, Poland

Introduction

According to agricultural protocols, seeds of wheat may be sown at 5-10 cm depth in the soil, which means that during the first few days of their development, their leaves develop in the absence of light, and thus got etiolated and their proplastids differentiate into etioplasts. During this, they may be directly exposed to soil salinity, which may also affect how they are greening after they reach sunlight. Thus, we wanted to investigate how various concentrations of different salts influenced the transformation of etioplasts into chloroplasts, and the biosynthesis of chlorophylls (Chl-s) and the assembly of the photosynthetic apparatus.

Results and Discussion

Greening occurred in a control-like manner (i.e. similarly to segments greened on Hoagland solution) in case of 300 mM KCl. Chloroplast differentiation and the development of the active photosynthetic apparatus was somewhat slowed down in segments greened on 300 mM NaCl or $CaCl_2$, 600 mM KNO_3 or KCl. Complete inhibition of the etioplast-to-chloroplast transformation and Chl accumulation were observed if greening was carried out on 600 mM NaCl, $NaNO_3$ or NaCl:KCl (1:1) solutions. In the latter cases, i.e. in the presence of high concentrations of sodium ions, a peculiar swelling of intrathylakoidal space of the (pro)thylakoids was also observed.

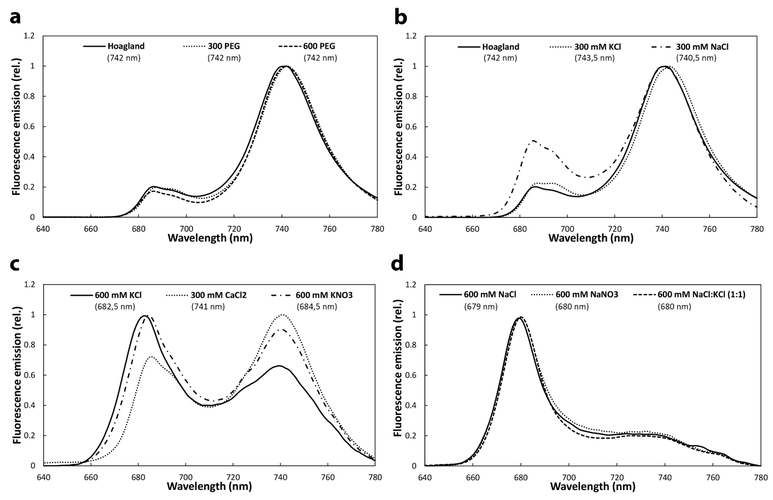


Figure 3: Normalized and averaged 77K fluorescence emission spectra of etiolated wheat (*Triticum aestivum* L. cv. Mv. Béres) leaf segments floated on various solutions for 1.5 h in the dark and then greened for 16 h on the same solution. Applied solutions: Hoagland, 300 PEG, 600 PEG (a), Hoagland, 300 mM KCl, 300 mM NaCl, (b), 300 mM CaCl2 600 mM KCl, 600 mM KNO3 (c), 600 mM NaCl, 600 mM NaNO3, and 600 mM NaCl:KCl (1:1) (d). Excitation wavelength: 440 nm. The position of the fluorescence emission maxima of the spectra are also indicated in parenthesis for all treatments. (n=11-44)

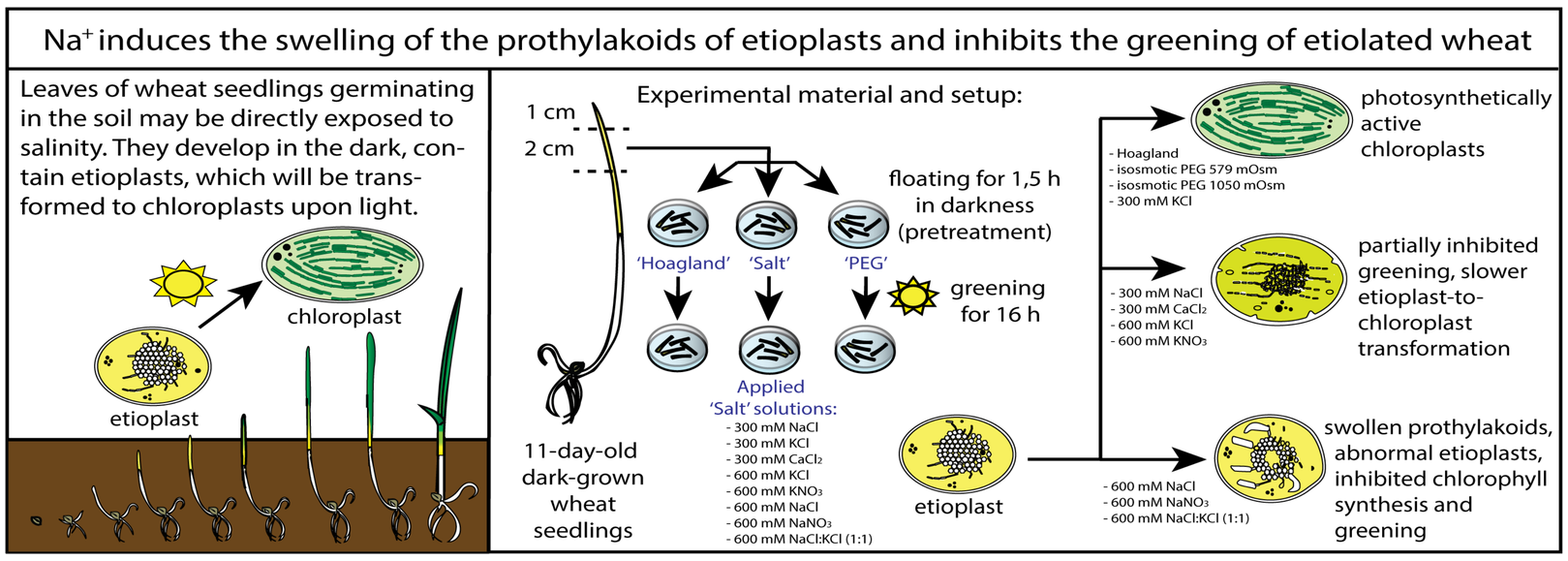


Figure 1: Graphical abstract of the poster.

Methodology

Leaf segments of 8 to 11-day-old dark-germinated wheat (*Triticum aestivum* L. cv. Mv Béres) were pretreated by floating on various salt solutions (600 mM NaCl, 600 mM KCl, 600 mM $NaNO_3$, 600 mM KNO_3, 300 mM KCl, 300 mM NaCl or 300 mM $CaCl_2$) for 1.5 h in the dark, and then illuminated on the same solutions for 16 h with white light of low intensity (50 µmol photons m-2 s-1). After the treatment, absorption spectroscopy was used to determine the Chl and carotenoid contents; gel electrophoresis, 77K fluorescence spectroscopy and Chl fluorescence transients to characterize the photosynthetic apparatus; and transmission electron microscopy to characterize plastid ultrastructure.

Our findings suggest that elevated levels of Na^+ (600 mM), rather than K^+ (600 mM) or Ca_2^+ (300 mM), had the most adverse impact on both the greening process and the structure of etioplasts. Additionally, in our experimental setup, the characteristic swelling of the (pro)thylakoid lumen was notably linked to the presence of high Na^+ concentrations. Regarding anions, Cl^- had a more negative influence on thylakoid development than NO_3^-.

Conclusions

These data suggest that KCl or CaCl2, especially when applied in lower concentrations, may be considered as eco-friendly compounds for de-icing roads, as they had less harmful effect on the structure and function of etioplasts in germinating seedlings within the soil, as well as on their subsequent greening process upon reaching the soil surface than NaCl.

References

[1] Sóti, A., Ounoki, R., Kósa, A., Mysliwa-Kurdziel, B., Sárvári, É., & Solymosi, K. (2023). Ionic, not the osmotic component, is responsible for the salinity-induced inhibition of greening in etiolated wheat (Triticum aestivum L. cv. Mv Béres) leaves: a comparative study. Planta, 258(5), 102.

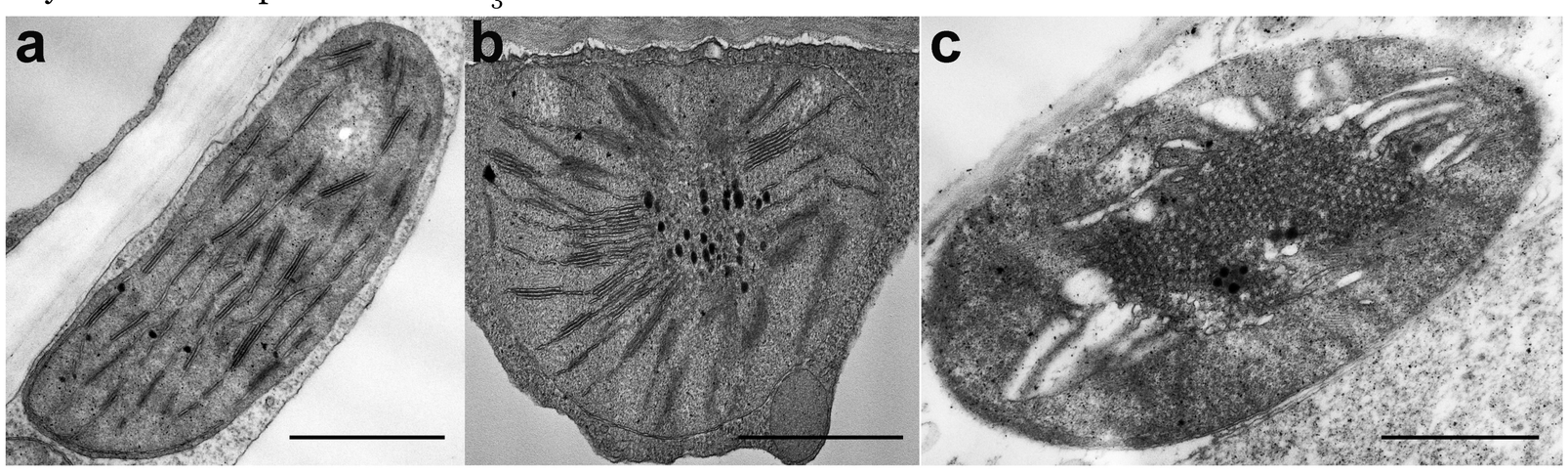


Figure 2: Typical plastid ultrastructure after 1.5 h dark pretreatment followed by 16 h greening of wheat (*Triticum aestivum* L. Cv. Mv. Béres) leaf segments floating on different solutions: Hoagland (a), 300 mM NaCl (b), 600 mM $NaNO_3$ (c). Bar: 1 µm (a-b) and 0,5 µm (c).

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