# $Na^+$-dependent $NO_3^-$ uptake in leaf cells of the seagrass *Posidonia oceanica* L. Delile

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*Posidonia oceanica* (L.) Delile is an endemic Mediterranean seagrass of recognized ecological significance and, as other seagrasses, this species has secondarily adapted to live in the marine environment. In this alkaline medium with a high $Na^+$ concentration (0.5 M), the high inwardly directed electrochemical potential gradient for sodium is used in the seagrass *Zostera marina* to energize the uptake of nitrate[1] and phosphate that usually occur at concentration below 10 µM. Here we summarize several evidences for the operation of a sodium-dependent high-affinity nitrate transport system at the plasma membrane of the mesophyll leaf cells of *P. oceanica.*

Leaf cells of *P. oceanica* possess a $H^+$-ATPase as a primary pump, exhibit a plasma membrane potential ($E_m$) of -174 ± 10 mV and show reduced $Na^+$ permeability. The addition of micromolar nitrate concentrations induces membrane depolarizations that show saturation kinetics. Curve fitting of the values renders a semisaturation constant ($K_m$) of 21.3 ± 6.6 µM and a maximum depolarization ($D_{max}$) of 7 ± 1 mV. In dark conditions, $D_{max}$ decreases by fifty percent but no significant effect is observed on the $K_m$ value. On the other hand, nitrate induced depolarizations show sodium dependence. The depolarizations induced by 100 µM $NO_3^-$ in media containing increasing $Na^+$ concentrations (from 0 to 250 mM) show saturation kinetics, rendering a $K_m$ value of 16 ± 5 mM $Na^+$. Moreover, the depolarization induced by 100 µM $NO_3^-$ is accompanied by a simultaneous increase of cytosolic sodium, measured by $Na^+$-sensitive microelectrodes, of 0.4 ± 0.2 mM above the resting cytosolic sodium concentration (17 ± 2 mM).

Finally, nitrate uptake rates, measured in depletion experiments, decreases by 50% and 80% in dark conditions and in the absence of $Na^+$, respectively, compared with control conditions (0.5 M $Na^+$ and light).

All together, these results strongly suggest that $NO_3^-$ uptake in *P. oceanica* leaf cells is mediated by a high-affinity nitrate carrier that uses $Na^+$ as the driving ion.

[1] Rubio et al. (2005). J. Exp. Bot, 412: 613-622.
Project Funding: CTM 2011-30356. (MEC)