EGU2020-11475
https://doi.org/10.5194/egusphere-egu2020-11475
EGU General Assembly 2020

Diffusive limitation to photosynthesis and plant-microbe N competition dominate the urban lawn response to secondary salinization

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Release of de-icing agents is the main cause of increasing soil salinization in urban and rural areas. Grasses are the dominant vegetation in urban lawns and are exposed to different rates of soil salinization depending on the distance to the paved salt-affected surfaces. The capacity of these ecosystems to maintain C sequestration and nutrient cycling functioning depends on the sensitivity to salinization of the main players: primary producers and their interaction with microbial community.

In this mesocosm study we aimed to evaluating the impact of soil secondary salinization rates on the functioning of *Lolium perenne*. Salinization treatments were applied for two months in spring, irrigating the mesocosms with the commonly used de-icing agent NaCl at two concentration, 30 mM (low salinity treatment) and 90 mM (moderate salinity treatment). The leaf physiological responses of Lolium were assessed monitoring photosynthetic rates (A), stomatal conductance (g_s) mesophyll conductance (g_m), carboxylation capacity (V_{cmax}). Quantitative limitation analysis (QLA) was applied to calculate the relative contribution of diffusive and biochemical limitation to photosynthesis under salinization. Productivity was estimated by regular mowing of plants to 4cm height. Finally, plants were harvested and analyzed on leaf mass per area (LMA), leaf N content and ^{15}N isotope composition. Rhizosphere soil was sampled and analyzed on the activity of enzymes involved in the cycling of C, N, S and P.

Salinity increased LMA and leaf N, reducing Lolium aboveground productivity. Photosynthetic rates were almost halved under both salinity treatments. QLA shows that photosynthesis was mainly limited by g_m, limitation accounting for 68% and 54% of the total limitation in 30mM and 90mM, respectively. g_s reduction significantly limited photosynthesis only in 90 mM (32% of total limitation), while biochemical limitations (due to a reduction in V_{cmax}) remained below 20% of the total limitation in both treatments.

Mesophyll conductance to CO_2 depends on leaf anatomical and biochemical traits and is usually negatively related to LMA. The increased LMA observed under salinity treatments suggests that changes in the leaf structure (like increased cell wall thickness) could be responsible for most of the A (and consequently productivity) reduction. On the other hand, the increased leaf N content is in agreement with the lack of significant reduction in V_{cmax}. Accumulation of N compounds in leaves in response to salinization was accompanied by a decline in soil extracellular enzymes involved in N and other cycles. Over-competing of the microbial pool in access to nutrients by vegetation could be suggested in conditions of salinization. Because the belowground biomass was not affected, decline in C losses with salinization could be hypothesize which should balance the shortage in C inputs.

In conclusion, salinization mainly limited A through g_m limitation, probably associated to the increased LMA. At the same time, altering the capacity of the microbial pool to compete for N, it increased leaf N, possibly reducing the impact of biochemical limitation on A and avoiding a further A and productivity decline.

Experiment was financially supported by the Russian Science Foundation, project No.17-77-20046.