Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.16122

Leaves over roots: direct atmospheric nutrient uptake in a high CO2 world sustains plant nutrition

ANTON LOKSHIN SR.[1], AVNER GROSS[2] AND DANIEL PALCHAN[3]

[1]Ben Gurion University of the Negev

[2]ben gurion university of the negev

[3]Ariel University

Presenting Author: lokshinanton@gmail.com

Desert dust, volcanic ash and fire ash are the most abundant natural atmospheric particles. These particles considered as an important nutrient source that controls the long-term productivity of infertile terrestrial ecosystems, by replenishing soil nutrient stocks. However, currently we do not know whether atmospheric deposition can act as a direct, alternative source for nutrients. These are particles enriched with phosphorus (P) and other essential macro and micronutrients such as: K, Ca, Mg, Zn, Cu, Fe, Mn, Zn, and Mo.

The current research shows that elevated CO_2 (eCO_2) in the atmosphere has positive and negative effects: On the positive side, increase of CO_2 levels is predicted to result with an increase in photosynthesis leading to improved primary biomass production and thus enhancement of CO_2 capture. On the other hand, at eCO_2 plants show decreased concentrations of mineral nutrients in most of their organs, suggesting downregulation of the activity of the membrane transporters involved in root nutrient uptake; a decreased ability to assimilate nutrients from the roots system.

Preliminary results of recent studies had shown that plants can utilize P via foliar nutrient uptake mechanism, directly from dust that settled on plant's leaves. Since the efficiency of roots to assimilate nutrients is projected to decrease in future eCO_2, foliar nutrient uptake may be a significant alternative pathway for plants to gain needed nutrients. In this work, we used atmospheric fertilization experiments – where we deposited dust directly on plant leaves – to show that atmospheric deposition boosts plant growth and fertilizes them through direct foliar nutrient uptake pathway. The foliar nutrient uptake mechanism was shown both in an ambient and eCO_2 levels for the three primary atmospheric particles mentioned above. We saw that desert dust and volcanic ash had significantly increased concentration of Fe and Ni at eCO_2 in comparison with ambient CO_2 levels. Our results demonstrate that foliar nutrient uptake is a significant mechanism at immediate timescales, particularly under eCO_2 levels. Furthermore, that the direct pathway of foliage nutrients assimilation, partially compensate roots downregulation. Finally, Foliar assimilation has the potential to regulate carbon sink processes and nutrient cycles in future climate.