

Phosphorus from desert dust can be directly utilized by plant leaves

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Phosphorus (P) scarcity constrains plant growth in many ecosystems worldwide. In P poor ecosystems, biogeochemical theory links plant productivity with the deposition of P-rich desert dust. The traditional view is that plants acquire P from soil exclusively via roots. Here we show that P deficient plants acquire insoluble P from desert dust directly via their leaves. Foliar P uptake from desert dust doubled the growth of chickpea and wheat, two widely cultivated crops originating in the vicinity of the Syrian Desert. P deficiency enabled acquisition of insoluble P forms conventionally perceived as unavailable for plants. P deficiency induced leaf modifications increased foliar dust capture, acidified the leaf surface and, in chickpea, enhanced exudation of P-solubilizing organic acids. The abovementioned foliar responses are comparable to known root responses and thus show convergent adaptations to P uptake. Foliar responses did not occur in maize, which displayed only a marginal response to dust. Assuming foliar dust P uptake trait is common among plant communities, we estimate the effective P utilization from desert dust to be several folds higher than previously postulated, and should be incorporated into terrestrial ecosystem models and into traditional frameworks of ecosystems P budgets.