Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.35286

Pedogenic carbonate formation in arid environments enhanced by oxalate microbial decomposition

RONI GRAYEVSKY, OMRI FINKEL AND SIMON EMMANUEL

The Hebrew University of Jerusalem

Oxalate is a dicarboxylic acid produced by approximately 80% of plant families, and it readily binds with calcium to form calcium oxalate minerals in plant tissue. When these minerals enter the soil, oxalotrophic bacteria decompose the oxalate, preventing its accumulation. This microbial decomposition raises soil pH, which can in turn facilitate the precipitation of carbonate minerals. This process is known as the oxalate-carbonate pathway and can cause pedogenic carbonate minerals to accumulate in otherwise acidic soils. Pedogenic carbonate improves soil structure and stability, buffers the soil pH, and may serve as a long-term carbon sink. While most research on the oxalate-carbonate pathway has focused on acidic soils, its role in pedogenic carbonate formation in alkaline soils remains unclear. Such soils are common in arid and semi-arid environments and are typically already rich in carbonate minerals. Here, we investigated the degradation of oxalate by bacteria in a set of laboratory experiments under a range of pH conditions. We isolated oxalotrophic bacterial strain from a semi-arid soil, cultivated it in media containing calcium oxalate as the main carbon source, supplemented with calcium carbonate. Our results show that oxalate degradation begins within 6 to 8 days of incubation and is complete after 20 days, accompanied by a pH increase of 2 units. Notably, approximately 85% of oxalate-derived calcium was converted to calcium carbonate. In control treatments, the same strain was cultured without oxalate; although a pH increase of one unit was observed, no calcium carbonate precipitation occurred. Our findings demonstrate that the oxalate-carbonate pathway is not restricted to acidic soils but can operate effectively in alkaline environments with the potential to enhance pedogenic carbonate formation and improve soil properties in arid and semi-arid regions.