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The role of prokaryotes and their extracellular polymeric substances on soil aggregation in carbonate containing semiarid grasslands

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Individual plant species form so-called resource islands in the barren semiarid landscape, whereby many soil properties are enhanced including soil structure. Within the soil structure, mostly studied as soil aggregates, microaggregates (<250µm) form fundamental components, reducing potential erosion of finer particles and subsequent loss of nutrients. Extracellular polymeric substances (EPS) are considered an important glue determining aggregation in addition to inorganic binding agents such as carbonates and clay minerals. However, the role of the soil prokaryotic community in EPS formation and consequently for microaggregation in natural environments has not been clarified yet. EPS should be particularly important under semiarid conditions as they form a protection mechanism of the prokaryotes against desiccation. Therefore, we examined the influence of the prokaryotic community on soil EPS content and subsequently on soil aggregation in semiarid grasslands, with respect to the parent material of soil formation, common plant species and the distance to the plant.

During two sampling campaigns in spring 2017 and 2018, soil samples were taken over a distance gradient from two major semiarid grassland plant species in Southern Spain, the legume shrub *Anthyllis cytisoides* and the grass tussock *Macrochloa tenacissima*, to the surrounding bare soil. While topsoil was sampled in five distances to the plant during the first sampling campaign, the second one focused stronger on the root influence, hence rhizoplane and rhizosphere were sampled. Additionally, two sites with different parent materials were chosen to scale the effect of EPS on soil aggregation in the presence of inorganic binding agents (here carbonates). Total community DNA and EPS were extracted, followed by quantification of EPS-saccharides and bacterial abundance, as well as examination of the prokaryotic community composition by

Illumina amplicon sequencing of the 16S rRNA genes. Further, the particle size distribution of (micro)aggregates in water was determined, with and without ultrasound treatment, as a measure of soil aggregate size distribution and stability.

Based on the first sampling campaign, we found that the overall prokaryotic community composition differed between the two sites, but not between plant species. Interdependencies between the community composition and EPS content were revealed, whereby soil organic matter (SOM) seems to be a regulating factor as increasing SOM contents resulted in more EPS-saccharides. Soil microaggregation in the topsoil was enhanced by the plant canopy, especially at the edge of *Macrochloa* tussocks. Contrary to the expectation that increasing inorganic C contents would diminish the importance of EPS, the parent material richest in inorganic C results in a significant effect of EPS-saccharides on microaggregation.

First results of the second sampling campaign indicate that even in the rhizoplane and rhizosphere, parent material had a dominating influence on the prokaryotic community composition. As EPS-saccharide contents and soil aggregation followed a similar decreasing trend with distance to the roots and canopy cover, interdependencies are expected.

From the outcomes until now, we can conclude that the availability of decomposable OM influences the prokaryotic community composition and thereby triggers EPS production, whereas large contents of polyvalent cations from carbonates promote the stabilizing effect of EPS on microaggregates.