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Extracellular polymeric substances (EPS) production in semiarid resource islands: Link to microbial community composition and effects on soil aggregation

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Under semiarid climate conditions complex soil-vegetation interactions are present. Individual plant species form so-called resource islands in the barren landscape, whereby many soil properties are enhanced. Additionally, every plant species has its own root shape, canopy influences and specific root exudates, shaping the microbial community composition within these resource islands.

These resource islands are hotspots of microbial activity in the barren landscape. Despite the improved conditions, the microbial community experiences drought stress on a regular base. To increase their endurance, microbes form a more stable environment in which to live by producing extracellular polymeric substances (EPS). EPS consist mainly of exopolysaccharides, proteins and other molecules like DNA. As EPS adsorbs to mineral surfaces and forms bridges between them, it is widely hypothesized that it influences soil aggregate formation and stability. The theoretical effect of this microbial glue on soil aggregation is not well studied, particularly not under natural conditions.

To examine the role of different plant species and lithology's on shaping the microbial community and EPS production, sites were selected on south facing slopes in the Sierrra de los Filabres and Sierra Nevada (Almeria, Spain). This semiarid part of Europe is dominated by a sparse vegetation cover on shallow, poorly developed soils. The upper 5 cm of the soil was sampled over a distance gradient from the dominating Anthyllis cytisoides and Macrochloa tenacissima plant species, up to 70 cm into the bare interspace (n=5).

Besides quantification of general soil properties, EPS was extracted using a cation exchange resin and its constituents quantified. Wetting properties of the soil samples and microaggregates was examined by contact angle analysis using the sessile drop method. Changes in the composition of the bacterial communities were assessed by Denaturing Gel Electrophoresis (DGGE) with 16S rRNA genes amplified from total community DNA of the soil samples. Furthermore, microaggregate stability will be tested using ultrasound as energy input and a laser particle size scanner to determine the reduction in particle size after energy application.

First results indicated that plant effects were more pronounced than lithology in shaping the microbial community in their resource islands. A similar trend was also found in the wetting properties of the microaggregates. Although they could not be classified as hydrophobic, Anthyllis shrub species seems to reduce wettability more than the Macrochloa grass species. A link between EPS-saccharide and contact angle of the particles was observed, possibly pointing to a conditioning by EPS production. Preliminary results from the microaggregate stability test indicated more stable microaggregates under Macrochloa, especially at the canopy edge. It seems that microorganisms influenced by plant species are actively involved in shaping different soil properties by producing EPS.