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Influence of Acacia trees on soil nutrient levels in arid lands

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The potential of scattered trees as keystone structures in restoring degraded environments is gaining importance. Scattered trees have strong influence on their abiotic environment, mainly causing changes in microclimate, water budget and soil properties. They often function as 'nursing trees', facilitating the recruitment of other plants. Acacia raddiana is such a keystone species which persists on the edge of the Sahara desert. The study was conducted in a forest-steppe ecosystem in central Tunisia where several reforestation campaigns with Acacia took place. To indentify the impact of those trees on soil nutrients, changes in nutrient levels under scattered trees of three age stages were examined for the upper soil layer (0-10 cm) at five microsites with increasing distance from the trunk. In addition, changes in soil nutrient levels with depth underneath and outside the canopy were determined for the 0-30 cm soil layer. Higher concentrations of organic matter (OM) were found along the gradient from underneath to outside the canopy for large trees compared to medium and small trees, especially at microsites close to the trunk. Levels of soluble K, electrical conductivity (EC), available P, OM, total C and N decreased whereas pH and levels of soluble Mg increased with increasing distance from tree. Levels of soluble Ca and Na remained unchanged along the gradient. At the microsite closest to the trunk a significant decrease in levels of soluble K, EC, OM, available P, total C and N, while a significant increase in pH was found with increasing depth. The concentration of other nutrients remained unchanged or declined not differently underneath compared to outside the canopy with increasing depth. Differences in nutrient levels were largely driven by greater inputs of organic matter under trees. Hence, Acacia trees can affect the productivity and reproduction of understory species with the latter in term an important source of organic matter. This positive feedback mechanism is of crucial importance for soil nutrient conservation and the restoration of degraded arid environments.