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Effect of Inoculation of Acacia senegal mature trees with Mycorrhiza and Rhizobia on soil properties and microbial community structure

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Inoculation of legume plants with symbiotic microorganisms is widely used to improve their development and productivity. The objective of this study was to investigate the effect of inoculation of Acacia senegal mature trees with rhizobium (Sinorhizobium) and arbuscular mycorrhizal fungus (G. mosseae, G. fasciculatum, G. intraradices) either singly or in combination, on soil properties, activity and the genetic structure of soil microbial communities. The experiment set up in Southern Senegal consisted of 4 randomized blocks of A. senegal mature trees with 4 treatments including inoculated trees with Rhizobium (R), mycorrhizal fungus (M) and with Rhizobium+mycorhizal fungus (RM) and non-inoculated control (CON). Soil were sampled 2 years after the inoculation. Soil pH, C and N and available P contents were measured. The microbial abundance and activity were measured in terms of microbial biomass C (MBC) and basal soil respiration. The community structure of the total bacterial, diazotrophic and denitrifying communities was assessed by denaturing gradient gel electrophoresis of 16S rDNA, nifH and nirK genes respectively.

Inoculations with symbiont under field conditions have increased soil pH. The C and N contents were enhanced in the dual-inoculated treatments (RM). The mycorrhized treatment have displayed the lowest available P contents while RM and R treatments exhibited higher contents rates. The microbial biomass C rates were higher in treatments co-inoculated with AM fungi and Rhizobium than in those inoculated singly with AM fungi or Rhizobium strains. The basal soil respiration were positively correlated to MBC, and the highest rates were found in the co-inoculated treatments.

Fingerprints of 16S rDNA gene exhibited similar patterns between inoculated treatments and the control showing that the inoculation of mature trees have not impacted the total bacterial community structure. In contrast, the inoculated treatments have displayed individually different diazotrophic and denitrifying communities fingerprints, indicating that the inoculation with microsymbionts have modified the genetic structure of the two functional communities in soil. Further, the diazotrophic community richness was reduced over the control indicating the impact of the addition of symbionts on the free-living N2-fixing bacterial (nifH) diversity.

This study shows that inoculation of A. senegal mature trees with rhizobium and arbuscular mycorrhizal fungus has enhanced soil biofunctioning and modified the genetic structure of microbial community involved in N-cycling. Combined inoculation of AM fungi and Rhizobium have improved these effects on chemical characteristics, microbial community abundance and activity demonstrating synergism between the two microsymbionts.