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Evidence for linkages between ecoenzyme activity and soil organic matter chemistry following encroachment of leguminous woody plant into grasslands.

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The encroachment of woody plants into grasslands is a worldwide phenomenon. In the Rio Grande Plains of southern Texas, subtropical thorn woodlands dominated by the N-fixing tree Prosopis glandulosa have largely replaced native grasslands as a result of fire suppression and extensive cattle grazing. This land cover change has resulted in the increase of belowground stocks of C, N, and P, changes to the amount and chemical nature of soil-stabilized plant biopolymers, and the composition and activity of soil microbes. Given that extracellular enzymes produced by plants and microbes are the principal means by which complex compounds are degraded and that the production of such enzymes is triggered or suppressed by changes in substrate and nutrient availability we sought to relate how these fundamental changes in this ecosystem are reflected in the activity of soil stabilized ecoenzymes and soil organic matter (SOM) chemistry in this system. We investigated a chronosequence of woody encroachment (14-86 yrs) into a C4-dominant grassland. We related the potential activities of five extracellular enzymes (arylamidase, acid phosphatase, -glucosidase, -glucosaminidase (NAGase, polyphenoloxidase (PPO)) and a general marker for hydrolytic activity, fluorescein diacetate (FDA) to the molecular composition and concentration of total hydrolysable amino acids and amino sugars, sugars, as well as CuO extractable lignin and substituted fatty acid to. When normalized to dry weight soil all chemical components increase in concentration with cluster age and all clusters have greater concentrations than background grasslands. All enzymes activities exhibit higher potential activity in woody clusters than grasslands but only NAGase and FDA increase with cluster age when normalized to dry weight of soil. Conversely, when normalized to SOC only lignin phenols, hydroxyl proline, and glucose from cellulose are positively correlated with cluster age indicating a selective accrual with respect to bulk Corg accrual. The opposite relationship between PPO and lignin indicates a suppression of PPO activity possibly by N-accrual in this leguminous system. Other relationships are evident among enzymes and land cover/age profiles and will be discussed. These results have important implications for the modeling of woodland-grassland conversion and the dynamics of biogeochemical cycles in this globally significant land cover change.