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COS 121-9: Early-successional dynamics of tree species growth in response to nitrogen and phosphorus fertilization in abandoned pasture in eastern Amazonia

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Contradictory evidence exists, mostly from chronosequence studies, about how nutrient impoverishment of degraded pastures can delay natural forest regeneration. We re-measured plots annually to test the effects of nutrient addition on early-successional trajectories on nutrient-poor, clayey Haplustox soil in Brazil. Originally covered with seasonal evergreen rainforest, the site had been subjected to 13 years of pasture, and after abandonment, further 9 years of occasional wildfires. Subsequently, 6 years of slow woody re-colonization preceded our factorial fertilization with N-only, P-only, N+P, versus unfertilized controls in triplicate 20x20m plots. Tree diameters and heights were measured before fertilization, and for 6 subsequent years. Initial tree growth responses to N gradually diminished. Overall, rates of woody biomass accumulation were similar to other sites in Amazonia with moderate to heavy prior pasture use. Tree species density, richness, and rank-abundance models indicated that diversity increased over time across treatments, but generally more slowly if fertilized. N₂-fixing legumes showed generally low, but increasing, though highly variable abundance and biomass. Polynomial mixed effects modeling indicated a significantly earlier peak of stem densities with N+P than N-only or P-only, associated with rapid recruitment and subsequent mortality of some pioneer tree species. Chronological clustering, canonical and non-metric multivariate analyses may suggest causal relationships among fertilization, successional dynamics and species characteristics. Similar, short-term tropical forest re-growth responses to N have been demonstrated previously. By contrast, present monitoring of tree population and community dynamics, over several years beyond short-term responses reported elsewhere, indicates that nutrient addition can also interfere with successional patterns.

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