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Soil Fertility Management In Oxisols of Manaus

Seasonal semi-evergreen forests occupy approximately 57% of the Amazon. Oxisols predominate in 45% of this region, primarily in the near-ustic and ustic soil moisture regimes. These soil and climatic properties characterize the ecosystem in Central Amazonia and many areas of the African humid tropics.

This setting contrasts with the more humid tropical environment of Yurimaguas, Peru, where research has been conducted in the fine loamy, siliceous Typic Paleudults. Cooperative agreements with EMBRAPA and IICA have provided the opportunity to perform research at EMBRAPA's UEPAE-Manaus station with the objective of adapting and improving soil management practices developed in sandy Ultisols to clayey Oxisols in a less humid area of Central Amazonia.

Continuous monitoring of soil nutrient availability was a key factor in developing sustainable cropping systems at Yurimaguas. Soil test data provided a guideline for judicious fertilizer applications and identified a progressive sequence of nutrient constraints, which were repeated with several continuous cropping studies in the Typic Paleudults. Investigations at Manaus have centered on a long-term study designed to monitor soil nutrient dynamics and identify the time after slash-and-burn clearing when individual soil nutrient levels limited crop productivity. After identifying specific soil nutrient constraints, satellite experiments were initiated to further refine soil-management techniques.

Data confirmed the possibility of continuous cropping of annual crops in the clayey Oxisols. Banding small rates of P also permitted continuous profits and earlier profits than with broadcast P. Calcium movement into the profile was enhanced by the combination of lime and gypsum. Nitrogen is a major limiting factor for annual crop production in these soils, and several green manures were found to be a good source of N. Both N response and the amounts of N supplied by different green manure species varied, however.

Nutrient Dynamics

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Procedures

An initial rice crop and three corn crops were grown in annual rotations with three crops of soybean and four crops of cowpea.

Results

The contributions of nutrient inputs to cumulative crop yields, during five years of continuous cropping, are shown in Figure 1. A total of 21 t/ha of grain was harvested from the complete fertilization treatment, whereas only 1.7 t/ha were obtained from the plot without lime or fertilizers. Total fertilizer inputs for the complete treatment corresponded to an annual average of 67 kg/ha of N, 66 of P and 80 of K. Single applications were also made of Cu at 1, Mo at 0.2 and lime at 2000 kg/ha. Phosphorus fertilization significantly increased yields, beginning with the first crop after slash-and-burn clearing. Similar yield responses to K and lime occurred after the second and third consecutive crops. Two additional treatments (Figure 1) demonstrate the effects on crop yields resulting from the omission of lime and from a 50% reduction of K fertilizer inputs to the complete fertilization treatment. With no lime, soil acidity progressively increased to the current level of 82% Al saturation. Increased K inputs to 99 kg/ha/yr also depressed yields as a result of K/Mg imbalances.

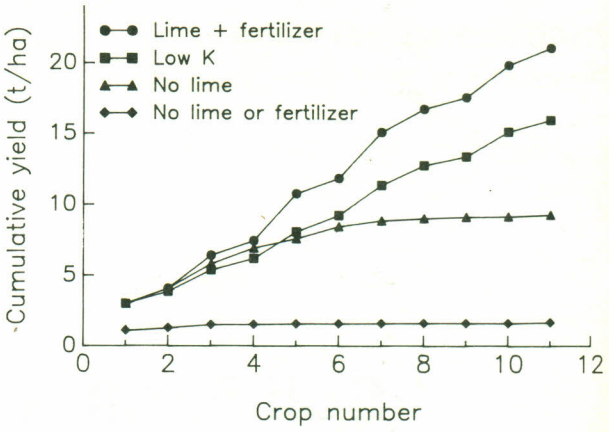

Figure 1. Cumulative crop yields over a five-year growing period at different levels of fertilizer and lime additions in the nutrient-dynamics experiment at Manaus, 1981-1986.