Introduction

The objective of this study was to evaluate the effect of charcoal, nitrogen and phosphorus on the nutritional status and productivity of banana.

Objectives

The experiment was performed from April 2002 to December 2003, in the Experimental Station of Embrapa Amazonia Ocidental, located in the geographica coordinates of 5° S and 59°2’ W, in the county of Manaus, Amazonas State, Brazil. The banana cultivar utilized was the ‘Caipira’, a triploid AAA (Figure 1).

Material and Methods

The soil was classified as dystrophic clayey Oxisol (Latossolo Amarelo following the Brazilian Classification) at Embrapa Amazonia Ocidental’s field station situated in Manaus, Amazonas State, Brazil. An experimental design with a 3 factorial scheme was used. Three levels of charcoal were tested (0, 13336 and 26672 L ha−1), as well as three dosages of phosphorus (34.4, 66.8 and 113.6 kg P2O5 ha−1) and three dosages of nitrogen (0, 90 and 180 kg N ha−1) per cycle. The mineral sources used were residues of charcoal (708 g C kg−1), simple super phosphate (20% P2O5 and 22% N) and urea (46% N, respectively). Two cycles of production were evaluated. The bananas were planted in holes of 0.6 m x 0.6 m x 0.6 m spaced 3 m x 2 m. The charcoal and the phosphorus rates were applied in holes, whereas the nitrogen was applied on the soil surface and divided into four applications. After the first bunch harvest (after 12 months), the treatments were applied in semi circles at the soil surface in front of the daughter pseudostems.

The quantities of N, P, K, Ca, Mg, S, Cu, Fe, Mn and Zn in the leaves (3rd leaf of the plant) were measured, as well as agronomic variables such as: height of the harvest, weight of the bunch, number of fruits per bunch, diameter of the fruit and diameter of the pulp.

The results were submitted to analysis of variance (F test), and regression, in accordance with the procedures described by Pinheiro Coimbra (1999). The software utilized was SYSTAT 6.0.

Results and discussion

The results of the first cycle showed significant increase in the weight of the bunch, the number of fruits per bunch, diameter of the fruit and diameter of the pulp due to charcoal application. In the second cycle, the weight of the bunch was not significantly changed by the applications of charcoal, phosphorus (P) and nitrogen (N). In spite of this, the larger charcoal application to the soil, caused an approximate banana yield increase of three tonnes per hectare.

In the first cycle, the quantity of B (boron) in the leaves increased significantly with an increasing amount of charcoal applied to the soil, whereas, an increase in the dosage of P reduced the quantity of this element (Figure 2 and 3). The higher concentrations of C (carbon) in soil might have increased the boron solubility applied as electric, which might be little available to plants. According Gupta (1993), showed a significant positive linear correlation between boron absorption and carbon content of soil. With regard to phosphorus, Leal (1993) has shown negative interaction between P and B in soil.

The results showed a significant interaction between charcoal and nitrogen, and charcoal and phosphorus in the first cycle. The treatments without charcoal showed an increase of nitrogen concentration in the leaves with increasing rates of N fertilizer (from 225 kg ha−1 to 450 kg ha−1), but the opposite occurred when charcoal was applied. Significantly at 26672 L ha−1 (Figure 4). The results corroborate the findings of Lehmann et al. (2003) who studied the effect of carbon on mineral nutrition of rice. They observed negative interaction between these two elements. The highest dosage of P fertilizer reduced the quantity of N in the leaves in the absence of charcoal, whereas charcoal applications of 26672 L ha−1 produced the opposite effect (Figure 5).

In the local edaphoclimatic conditions, the increase of P rates reduced the Mg level. Increasing N applications caused a decrease of leaf Mg levels, and an increase in Fe (iron) levels (Figure 7).

The results of charcoal applications significantly increased boron uptake of banana and reduce the uptake of magnesium.

Conclusions

1. Charcoal additions significantly increased boron uptake of banana and reduce the uptake of magnesium.
2. Treatments without charcoal had increased nitrogen concentration in leaves, from the N fertilizer level 225 kg ha−1 to 450 kg ha−1. The inverse occurred at the highest dosage of charcoal (26672 L ha−1).
3. The P foliar content was not affected by charcoal application, nitrogen and phosphorus in soil.
4. The N application enhance Fe uptake, while suppress Mg foliar uptake.

References