Yield, quality and nutritional status of MMex cassava grown on a tropical acid soil in response to nitrogen and lime

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INTRODUCTION

Cassava (*Manihot esculenta* Crantz) is the third largest carbohydrate source in the Caribbean. Over the past decade, cassava production has increased considerably aligned with food security concerns and the need for alternatives to imported cereals, potatoes and grains. Traditionally, low yields (8,000 kg ha^{-1}) are associated with genetic and ecological factors, including inadequate soil fertility and crop nutrient management. In an effort to improve yield, this study investigated the interactive effects of nitrogen application rate and lime on soil fertility, yield, crop nutrient concentration and post-harvest quality of cassava, cultivated on a tropical Ultisol (Typic Kanhaplaquults).

METHODOLOGY

Experimental Design

The study was conducted at the Central Experimental Station, Centeno, 10° 35' N, 61° 19' W in Trinidad and Tobago. Repeated trials (2015/16 and 2017/18) were conducted using a split plot design where liming treatments were assigned to main plots and N treatments applied to the subplots. Lime was applied at 2000 kg ha^{-1} to the limed main plot. Urea equivalent to 0, 50, 100, 200 and 400 kg N ha^{-1} was applied together with muriate of potash equivalent to 200 kg K_2O ha^{-1} in two split applications, one month after planting (MAP) and again at three MAP. Triple super phosphate equivalent to 80 kg P_2O_5 ha^{-1} was applied as a basal application pre-plant to all experimental units.

Nutritional analysis of soils

Composite soil samples per plot were taken after harvest. Samples were air-dried then crushed and sieved (2 mm) prior to laboratory analysis. Soil pH was measured in a 1:2.5 soil to water ratio using a pH meter (Orion Star AIII, Thermo Scientific, New Jersey, USA) equipped with a combination of a gel-filled glass electrode.

Yield

Tuber yield was measured from 6 plants within a micro plot (6 m²) for each treatment at 9 MAP. The yield was determined by weighing the total fresh tubers per micro plot, which was then expressed on a per hectare basis.

Post-harvest quality

The tubers were evaluated for the occurrence of vascular streaking using the Philippine Root Crop Research and Training Centre's (PRCRTC) scoring method based on the discoloration changes during postharvest physiological deterioration (PPD) (Uritani et al. 1983).

RESULTS

Crop yield increased significantly with the addition of N to a maximum at 100 kg N ha^{-1}. Doubling the rate to 200 kg N ha^{-1} resulted in a significant ($p<0.05$) reduction in yield (Fig. 1). Excluding 200 kg N ha-1 from the analysis resulted in a strong quadratic response (R^2 = 0.99) to N application rate.

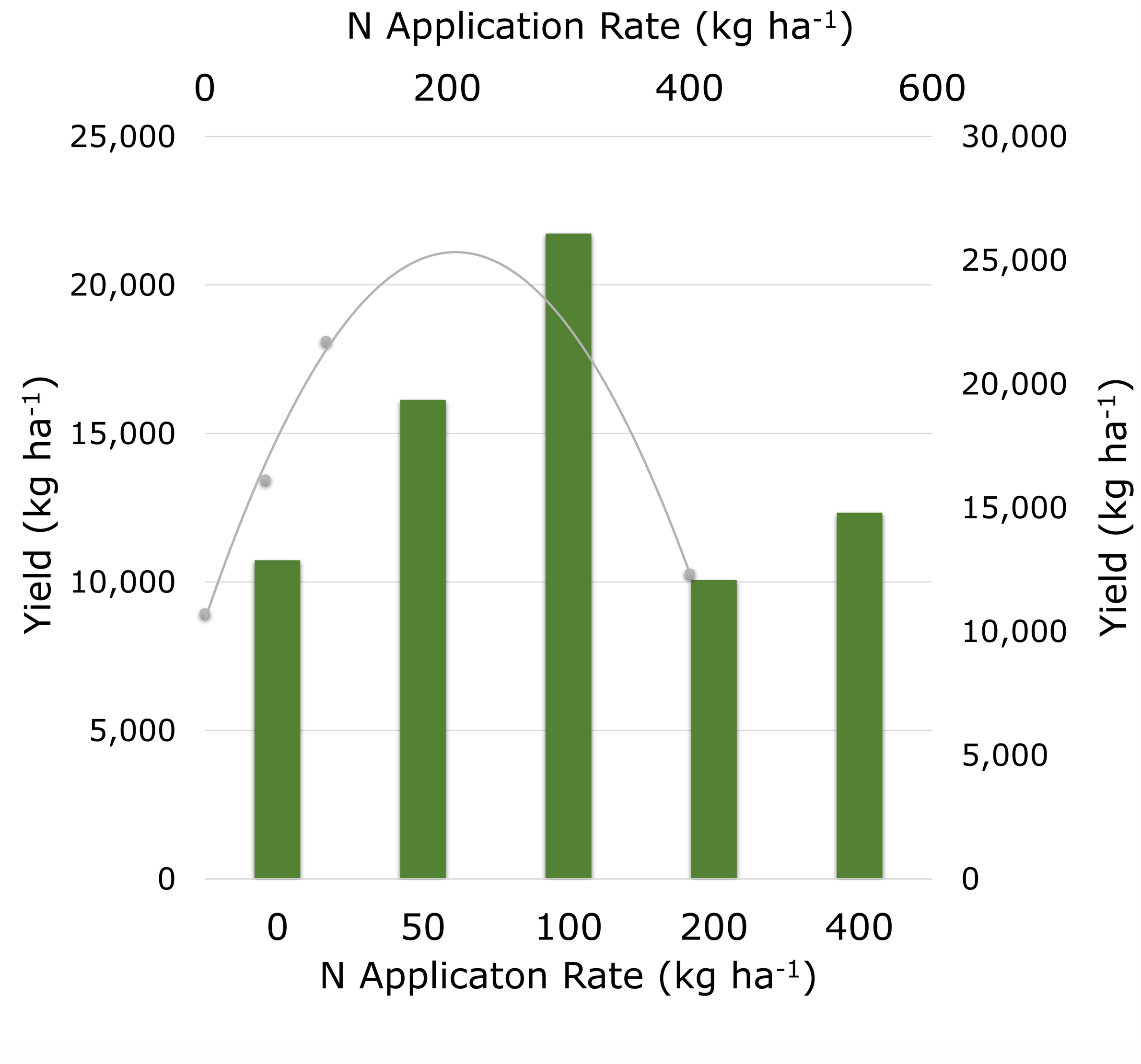

Figure 1 Crop yield influenced by N rate. Quadratic polynomial regression model explains the dependence of cassava yield on N application rate.

Soil pH was significantly ($p<0.05$) higher for limed treatments in both trials (Fig. 2). For the limed treatments soil pH increased significantly from the 1st to the 2nd trial.

The addition of lime and nitrogen reduced the occurrence of PPD in cassava tubers (Fig. 3). The lowest occurrence of PPD was observed in tubers at 200 kg N ha^{-1} with lime application, which was significantly lower than the limed control and all non-limed treatments.

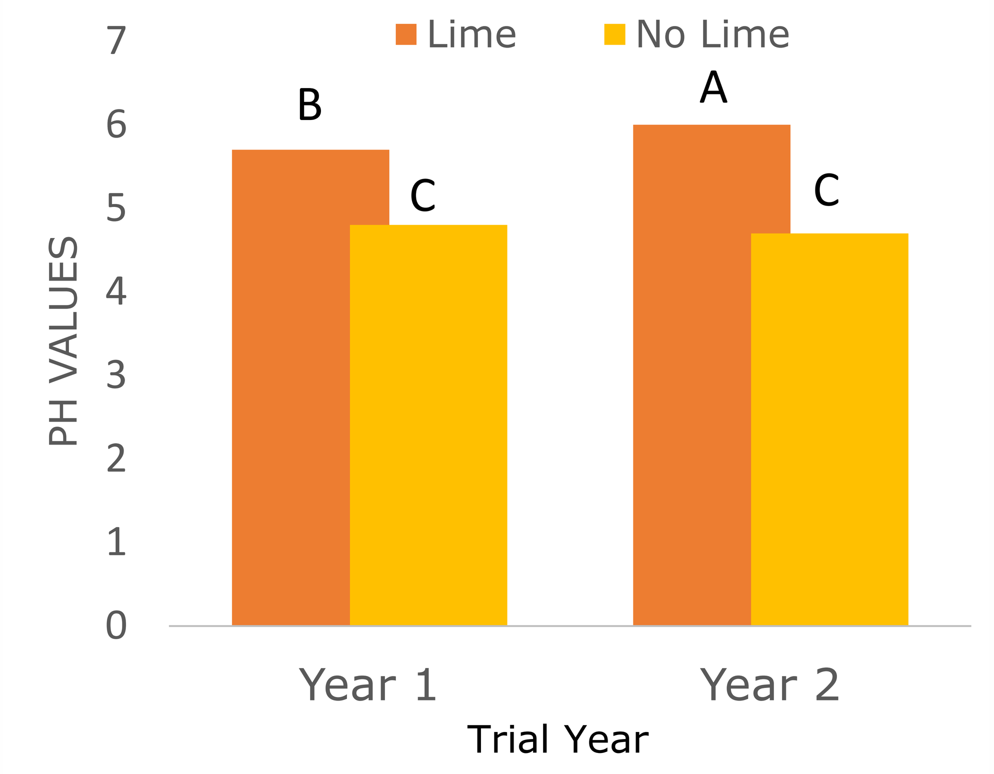

Figure 2 Soil pH as influenced by the interaction of trial year and lime

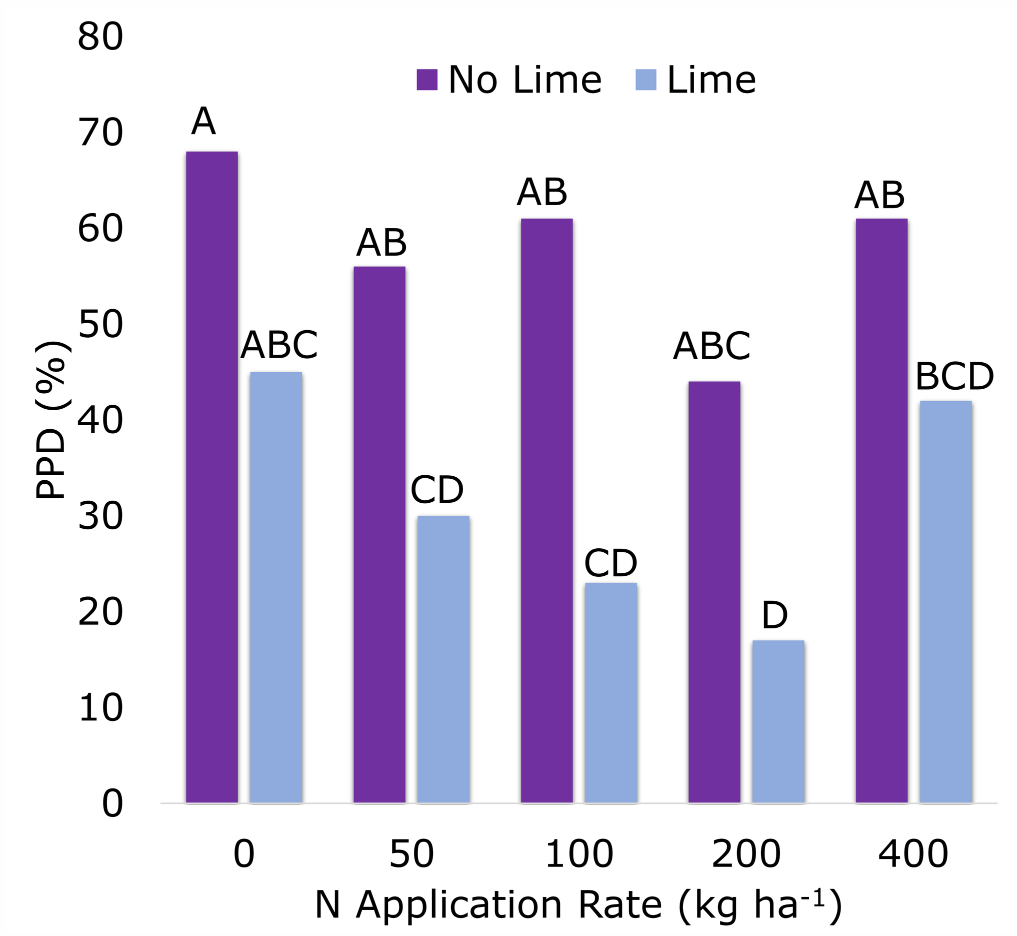

Figure 3 PPD in cassava influenced by trial year and N rate

Limed soil resulted in cassava with significantly ($p<0.05$) lower DM than non-limed soil in the 1st trial.(Fig. 4). The opposite occurred for the repeated trial.

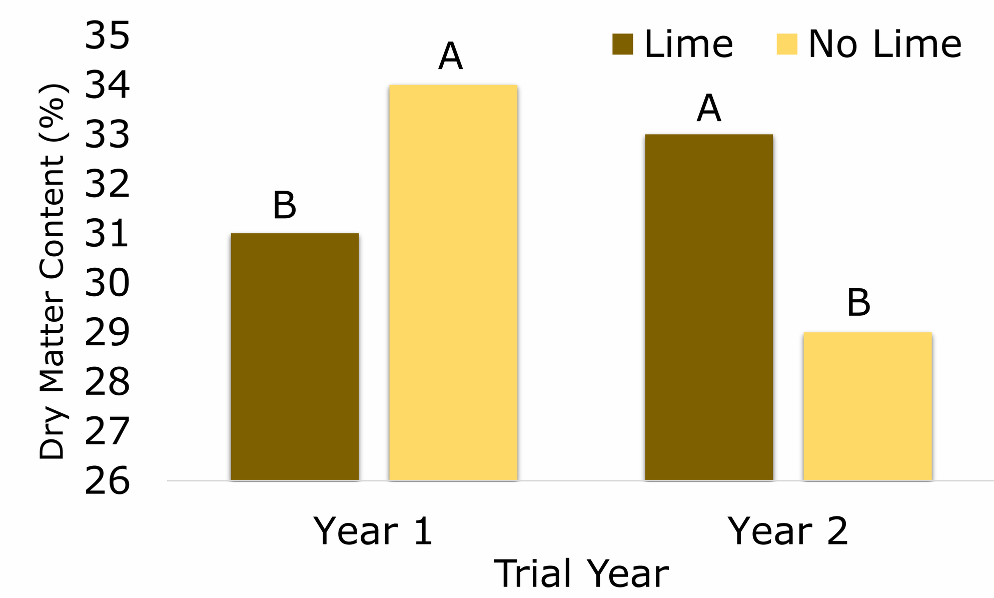

Figure 4 DM content of cassava tubers influenced by trial year and lime.

CONCLUSION

This study confirmed the effect of limestone and identified 100 kg N ha^{-1} as optimal for improved soil fertility, yield, crop nutrition, and post-harvest quality of cassava tubers.