SITE SPECIFIC MANAGEMENT OF AN OXISOL CULTIVATED WITH CORN FOR APPLICATION OF LIME AND GYPSUM

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ABSTRACT

The objective of this work was to identify the spatial variability of soil fertility, with emphasis in soil acidity, to define management zones for application of lime and gypsum at variable rate. This research was conducted in field (100 ha) located on a farm in Corinto, MG. The soil is classified as clayey Oxisol, cropped with corn and irrigated with a center-pivot. Grid cell of 1 ha was used for collecting soil samples from 0 to 20 cm and 20 to 40 cm depths. Data of pH, Al^{3+}, Ca^{2+}, Mg^{2+}, CEC, base saturation (BS), Al^{3+} saturation in the CEC at soil pH (effective CEC) and organic matter, were submitted to geostatistical analysis and interpolated by point-kriging using the modeled semi-variograms. Based on the maps of BS and Al^{3+} saturation, it was possible to define zones of management for application of lime and gypsum. The threshold used to define the rates of lime was 60 % of BS in the top of 20 cm. The criteria based on values of Ca (<0.5 $cmol_c\ dm^{-3}$) and Al^{3+} saturation (>25 %) in the subsoil (20 to 40 cm) were used for gypsum application. The rates of lime range from 0 to 3 t ha^{-1} and for gypsum of 0 and 1 t ha^{-1}. When the cost of site-specific soil acidity management was allocated over a useful lifetime of four years, the cost of the technological package of US$ 18.40 per hectare become economically feasible.

Key words: soil acidity, spatial variability, variable rate, economic aspects.

INTRODUCTION

Soil analysis should be the basis for all programs of soil fertility evaluation. It can be complemented by other techniques, but it is the only one that efficiently, on a routine basis, makes it possible to anticipate the existing soil constraint. However, the greatest difficulty for soil fertility evaluation is collecting the right soil samples to test and that represents the area sampled. Thus, there is the necessity to improve soil fertility diagnostic, and researchers have been searching for more efficient technologies on agronomic, economic and environmental aspects. One of these technologies is the use of the concept of site-specific for soil fertility management. The objective of this research was to identify the spatial variability of soil fertility, with emphasis in soil acidity, to define management zones for application of lime and gypsum at variable rate, in an Oxisol cropped with corn. Also, the profitability was evaluated to obtain the balance cost of soil sampling with the value of information.

METHODS

This research was conducted in a farm field (100 ha) located in Corinto (18º 13'S, 44º 36'W, 550 m above sea level), Minas Gerais state, starting in the 2007-2008 growing season. The soil is classified as a clayey Oxisol (47 % of clay), cropped with corn and irrigated with a center-pivot sprinkler irrigation system. A georeferenced grid cell of 1 ha, was used for collecting soil samples from 0 to 20 cm and 20 to 40 cm depths. Five soil cores were randomly collected within a 5-m radius of the grid-line intersection (node) and composited as one soil sample. Data of pH, Al^{3+}, Ca^{2+}, Mg^{2+}, CEC, percent base saturation (BS), percent Al^{3+} saturation in the CEC at soil pH (effective CEC) and organic matter were submitted to geostatistical analysis and interpolated by point-kriging using the modeled semi-variograms. Based on the maps of BS and Al^{3+} saturation, it was possible to define zones of management for application of lime and gypsum. The threshold used to define the rates of lime was 60 % of BS in the top of 20 cm. The criteria based on values of Ca (<0.5 $cmol_c\ dm^{-3}$) and Al^{3+} saturation (>25 %) in the subsoil (20 to 40 cm) were used for gypsum application. With these informations, maps of application of lime and gypsum at variable rate were generated. Based on these maps, lime and gypsum were applied at variable rates, on the soil surface, using a commercial spreader applicator. The costs of soil sampling with GPS, soil chemical analyses, field mapping with GIS and application of lime and gypsum at variable rate, are evaluated.

RESULTS AND CONCLUSIONS

The site in this study show large spatial variability in the soil attributes used as indicators of the soil acidity. In the topsoil (20 cm), spatial patterns in kriged BS show values ranging from about 40 to 60 % in a 100-ha field. This variability affords the opportunity to differential application of lime and the spatial scale makes it feasible technologically. Based on the map of BS, four management zones were established for lime application: zone 1 – 0.0 t ha^{-1}, representing 27 ha; zone 2 – 0.3 to <1.0 t ha^{-1}, representing 21 ha; zone 3 – 1.0 to <2.0 t ha^{-1}, representing 38 ha and; zone 4 – 2.0 to 3.0 t ha^{-1}, representing 13 ha. Field-averaged soil test for BS was 49 ± 10 %. For corn crop, the values of BS of 50 to 60 % are recommended. If the field were to be uniformly limed at a single rate to bring BS to 60 %, then, according to recommendation for corn, this would require 1.0 t ha^{-1} of lime. Although the total consumption of the limestone (99 t), is similar for both, uniform and variable rate application, the large variability in the soil acidity, justify the use of variable rate technology. For Al^{3+} saturation in the CEC at soil pH, the values in the soil surface range from 0 to 35 %. The subsoil (20 - 40 cm) presented high acidity, with values of Al^{3+} saturation ranging from 20 to 58 % in almost all field. Thus, according to criteria for gypsum recommendation, in 70 ha of the field, there is the opportunity for gypsum application at maximum rate of the 1.0 t ha^{-1}. The total variable cost for grid soil sampling, laboratory analyses, building soil maps and, application of lime and gypsum for 100 ha field was US$ 5,936.00, which represent a cost of the US$ 59.36 ha^{-1}. Allocating the cost of soil acidity management over a useful lifetime of four years, the cost of this technological package become relatively reasonable, US$ 18.40 ha^{-1}.