SOIL PHOSPHATE SPATIAL VARIABILITY UNDER *BRACHIARIA* LOW PRODUCTIVITY PASTURE

E.J. Corazza[1], M. Brossard[2], T. Muraoka[3] and M. A. Coelho Filho[4]
1. Graduate student (Doctor degree - IRD Scholarship) at ESALQ/USP (University of São Paulo, Brazil), CP 96, Lab. of Soil Fertility/CENA, 13400-970 - Piracicaba, SP Brazil (ecorazza@carpa.ciagri.usp.br)
2. IRD/Embrapa Cerrados, caixa postal 7091, 71619-970 Brasília, DF Brazil
3. CENA/USP, Lab. of Soil Fertility/CENA, 13400-970 - Piracicaba, SP Brazil.
4. Graduate student (Doctor degree - CAPES scholarship) at ESALQ/USP.

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INTRODUCTION

Phosphorus and nitrogen are the most chemical limiting soil productivity factors in cultivated pastures in the Cerrado Region in Brazil. However, regional literature shows a lack of data on soil phosphate contents and on the spatial variability of these parameters under pastures considered degraded or of low productivity. Knowing the phosphate spatial variability in soils under pasture is essential to make use of appropriate strategies of recovery and renewal. The nutrient levels vary in space and time in a plot. These differences would not necessarily be the cause of sampling errors, but hinder or impede the true representation of the soil's variability inside an area. For phosphorus, contradictory results with respect to field variability have been found in soils under pastures. The objective of this paper was to evaluate the spatial variability of available P contents in soils under *Brachiaria brizantha cv. Marandu* (BR) pastures of low productivity.

MATERIAL AND METHODS

The site was located (Fazenda Rio de Janeiro, Planaltina-GO, 15° S 14 ' and 47° W 42 ', at 826 m of altitude) on a red latosol cultivated with BR, showing low productivity levels, introduced in 1990 after deforestation of native vegetation. The sampling area, randomly chosen, was located at 70 m South-North bound and 140 m West-East bound and demarcated in a grid of 10 to 10 meters, with a regular grid of 98 sampling points, in a total area of 9,800 m^2 (Fig. 1). The ascendancy bound of the slope is in the y direction, from 0 to 130 m, with ± 5% declivity. In the marked line, there was a remainder swath, built by vegetation that was not removed by deforestation and burn. Simple samples of soil were collected in 1998, 0-10 cm of depth in each point, sampling among clump roots and within the clump root; 0.5 m^2 spots of the BR was collected, by a adjacent cut, proceeded by botanical division and fractions of green matter (GM), dry matter (DM) and litter (L) of BR was determined based on dry weight. The P plant contents were determined in composed samples of each line of the coordinate y, except for the remainder pile samples. After broadcasting of 40 kg ha^{-1} of P, applied as triple superphosphate, incorporated with heavy disk harrow ± 0.1m of depth (feb/99) the samples were collected (sept/99) in the same 1998 previously sampled points and more 24 sampling points in a grid of 2.5 x 2.5 m (Fig. 1).

The soil samples were air-dried and screened through a 2 mm stainless steel sieve. The phosphate (P) extraction was done by the resin extractor (Raij et al., 1983), and determined colorimetricaly. Plant P content was determined by after hidrogen peroxide and perchloric acid digestion (Adler & Wilcox, 1985). For all variables, descriptive statistic, correlations (statistica 6.0) and geoestatistical analyses (variowin2.2, Pannatier, 1995) were done.

RESULTS AND DISCUSSION

The semivariograms of P in the soil samples among clump roots and after fertilization were constructed. When analyzing the data, discarding the samples located at the remainder pile swath (Fig. 1) with higher values on the average compared to the other points, no spatial dependence structure was found, as well as in the plant's fractions (GM, DM, L). Nevertheless, there was a tendency of decrease in the P values in the ascendancy bound of the slope for the samples collected within the clump root (Fig. 2a) detected in a shape of the semivariograms. The semivariogram built with the original data indicates a false lineal behavior and nonstationarity, a trend present in a field was efficiently removed by median polishing (Hamlett et al, 1986). The semivariogram of the residues (Fig. 2b) indicates that the variable does not present structure of spatial dependence (pure nugget effect). In the total, there is no spatial dependence for the distance sampled (10 x 10 m grid) of the P variables in the soil among clump roots, within the clump root, after fertilized and in GM, DM, L of BR. It can be said that the sampling performed was not enough to detect spatial dependence, being necessary a larger concentration of samples for its characterization. No spatial dependence of P in the soil and in the fractions of the BR's biomass was observed. In consequence, the sampling procedure for low productivity pastures could be performed with random strategy with a minimum of 10 m distance between each sample point.

Comparing the P among and within the clump roots, two different situations were verified (Fig. 3). The samples around clump roots presented a mean and median different from the clump root, being around 45% below. Although the minimum values are practically the same, the maximum was approximately 4 times superior in the clump root (Fig. 3), demonstrating a larger variation of the data, (width**,** variance and standard deviation), at least the double of the sample's values around clump roots. This large variation is probably due to a larger concentration of root system in these samples, as the soil's profiles showed less distribution of roots aroundthe clump roots, although under the clump roots the physical properties also limited the development of the root system. The soil observation showed compacted volumes in a 5/10 to 30/50 cm layer.

The soil P content after the fertilizer application is6 times superior in the median (26.5 mg kg^{-1}) and 10 times in the mean (47.4 mg kg^{-1}) compared to P aroundclump roots (Fig. 3). The variability increased significantly. The minimum values of P are close to the ones before the application of fertilizers demonstrating that in these spotsfertilization did not occur. The maximum values are much higher than expected, and occurred in some areas where they were applied in excess. In some soil samples, during their preparing, some fertilizer grains were still not dissolved. The results of the sampling with the 2.5 m grid (Fig. 3) were inferior to the median (15.8 mg.kg^{-1}) and mean (19.7 mg.kg^{-1}) compared to the sampling in the 10 m grid, what shows a great variability of P application in the experimental area.

The correlation matrix to evaluate the relation between P in the soil and in the plant indicated there were not significant correlations between the P around clump roots and P in GM, DM and L (Fig. 4a). However, significant correlation were found between P in the clump root and P in the plant (Fig. 4b), with r^2 = 0.58 of lineal regression. These results confirm that the soil was exploited differently around clump roots and in the clump root, probably related to the heterogeneous distribution of the root system of BR, as it was observed in the soil profiles. The roots proliferation and the increasing P absorbed by the BR occurs in response to enriched localized sites by P supply (Jackson et al. 1990). In another point of view, the higher contents in the aerial parts might signifiy P accumulation because the P taken up by the plant could not be transformed into dry matter because for instance N or other factors were limiting. In this system, the nine-year-old plant clump root system has contributed to an increase of the phosphate availability, which could be explained by litter and vegetal belowground recycling materials. The P-resin and P-plant relation indicates a modification of the soil that stands out the need to investigate the P-root system and the shoot (P-plant) recycle.

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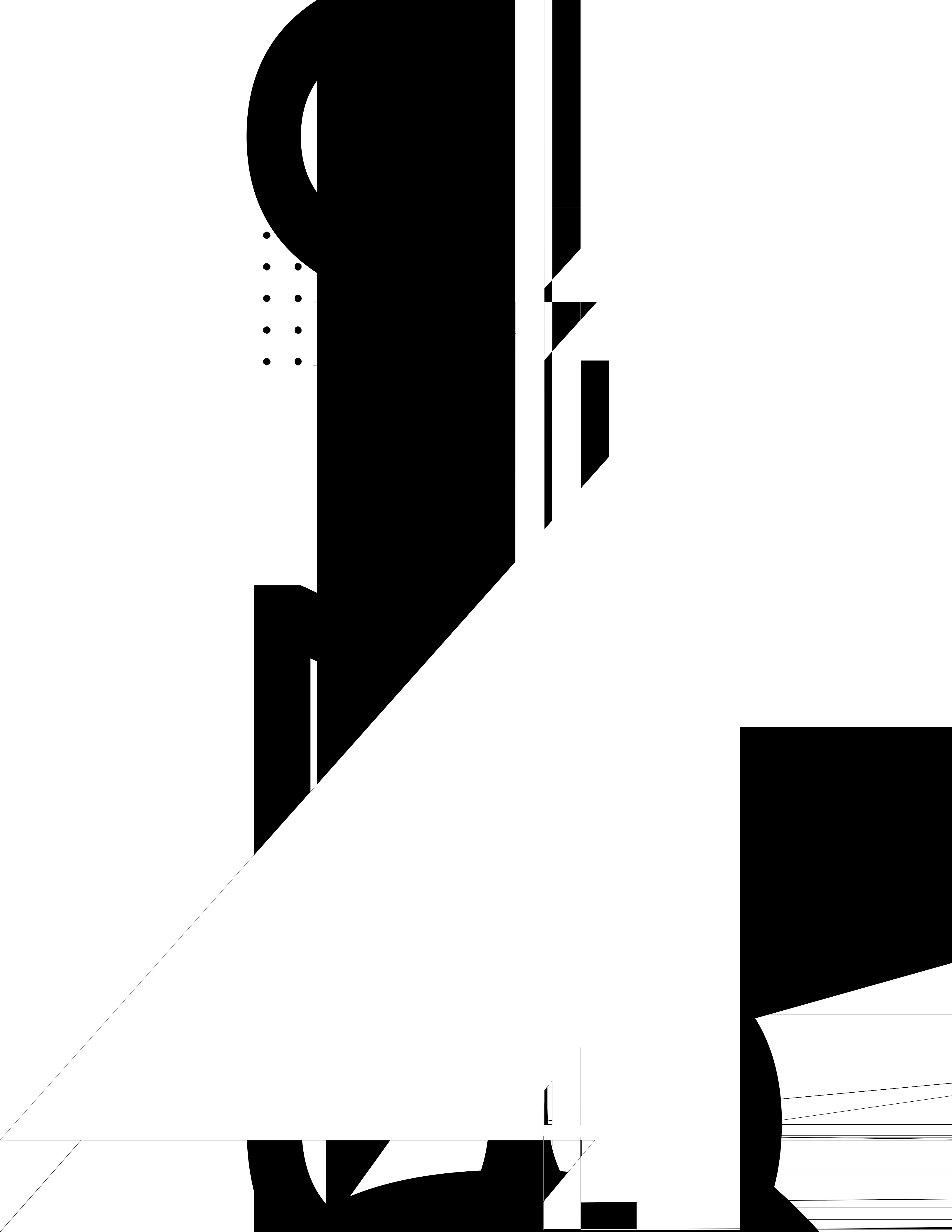

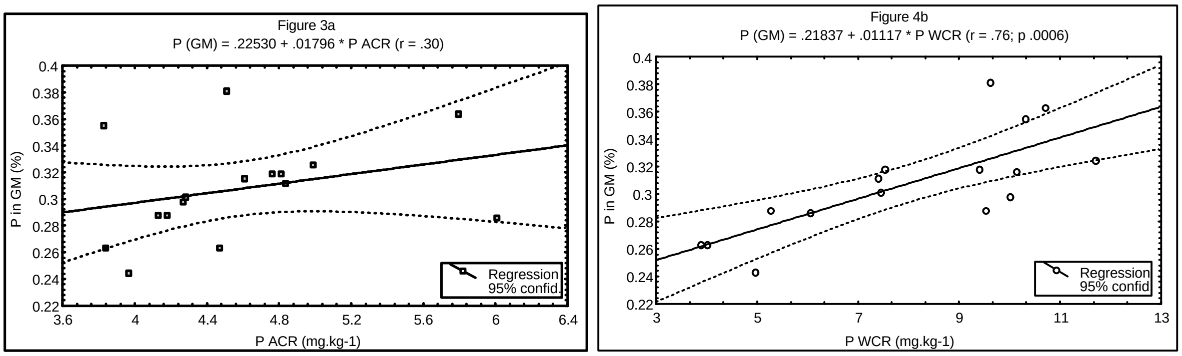

Figure 4. Correlation between soil P-resin among clump roots (ACR) and within the clump root (WCR) with P in GM of the BR.