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SPATIAL VARIABILITY OF MAXIMUM TEMPERATURE AND CHLOROPHYLL IN AN INTEGRATED AGRICULTURAL-FOREST SYSTEM

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ABSTRACT
The objective of this work was to study the variability of maximum temperature and chlorophyll A in an agroforestry system using the geostatistics technique. This study was carried out in an area of 0.8 hectares with an integrated crop and forestry system managed by Embrapa Agrossilvipastoral in Sinop, MT – Brazil. Results from semivariograms models have shown that maximum temperature had no spatial dependence detected, problaby because of the small size area where this variable seemed constant. Conversely, Chlorophyll A has shown spatial dependence after semivariogram adjustments. It was observed that the highest values of chlorophyll A were located where there were no trees and the lowest maximum temperatures close to the pequi trees, likely due the solar energy availability.
Key words: Geoestatistics; Forestry agriculture system; chlorophyll

INTRODUCTION

The majority of agricultural integrated systems involve various combinations, basically working with the planting, during the summer, of annual crops (rice, beans, corn, soybeans or sorghum) and trees, associated with forage species (brachiaria or panicum). The possibilities of combining the agricultural, livestock and forestry components, result in different integrated systems, such as crop-livestock-forest (ILPF), crop-livestock (ILP), silvopastoral (SSP) or agroforestry (SAF). In this system, the producer benefits from the more efficient use of his resources, obtaining an improvement in the quality of the soil and water with the possibility of decreasing the amount of use of pesticides (BALBINO et al., 2011). However, intense research is being carried out in order to answer questions related to the association of different elements in the integrated systems. For example: Is there spatial temperature variability in systems integrated with the forestry component? Does the photosynthetic activity, which allows, among other issues, the aid in the prediction of nitrogen fertilization (ARGENTA et al., 2001) vary in integrated systems? In this context, the goal of this work is was evaluate the variability of maximum temperature and chlorophyll in an agroforestry systems using the geostatistics technique.

MATERIAL AND METHODS

This study was carried out in an area of 0.8 hectares with an integrated crop and forestry system managed by Embrapa Agrossilvipastoral in Sinop, State of Mato Grosso, Brazil (11°52'26.0"S, 55°35'50.7"W). For the thermal study, the FLIR i7® camera (FLIR, Wilsonville, OR) was used, obtaining thermal images (ºC) in corn plants in stage R4, Caryocar brasiliense (pequi) and mahogany trees, carried out on May 18 of 2017. For the corn samples, three images were captured covering the temperature from the underside of the plant to its canopy. In the mahogany,and pequi trees two images were captured, of the trunk and the top. Subsequently, the average of the measurements of each plant was estimated. All images were collected in the early morning, between 8:30 am and 10:30 am on sunny days. For the thermal image processing, the FLIR Quick Report software was used. A feature of this software allows an area represented by a square to be moved by the user to that area

that best represents the target studied. Once the square was positioned, the maximum and minimum temperatures were available.

RESULTS AND DISCUSSIONS

The first step of the geostatistics analysis resulted in the estimation of semivariograms, which express the spatial dependence of the studied phenomenon. A trend was noticed at thesemivariogram estimated to chlorophyll A, after reaching the semivariogram, so the trend was withdrawn using the simplest surface, in this case the linear surface. The adjusted modelwith the least squares error was the exponential (15.8) in relation to the Gaussian (22.2) and the spherical (19.8). At the end of this process, the semivariogram settings were: Nugget effect: 17.3, range: 14.4 meters and 7.9 level. It was observed that the highest values of chlorophyll A were located where there were no trees and the l owest maximum temperatures close to the pequi trees. This result makes sense because where there was more availability of solar radiation, which means, there was conditions to more chlorophyll production. Regarding to the maximum temperature variable, it was observed that the data did not show spatial dependence, that is, the nugget effect was found. This case indicated the spatial random distribution, as the measure that increased the discontinuity at the origin of the semivariogram, the more random became the phenomenon that generated the variable under analysis (STURARO, 2015), making it impossible to apply geostatistics for this variable (Figure 1).

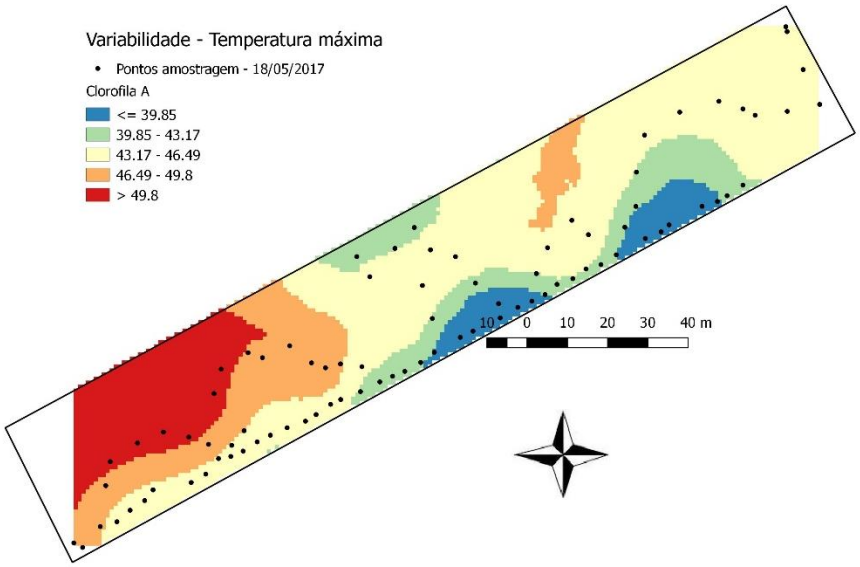

Figure 1. Spatial variability of chlorophyll A values using kriging technique performed by QGIS software.

CONCLUSIONS

The results of this study demonstrated that there was no spatial variability for the maximum temperature in the study area, suggesting that in the small size of the area the temperature remains constant. However, the variable chlorophyll A showed variability, found through the spherical model in the linear residue data. The highest estimated chlorophyll A values were located where there was more availability of solar radiation. For future work it is suggested to intensify the number of samples and that it be done in a predetermined random design, instead of zigzag, to better capture aspects of spatial dependence.

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