MOISTURE RESPONSE TO SPATIAL VARIATION OF PHYSICAL ATTRIBUTES IN DIFFERENT TILLAGE SISTEMS OF HAPLUDOX

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SUMMARY: The aim of this work was to analyze the moisture response to the spatial variation of density and particle size in a Hapludox under three different soil tillage systems (No-Till, Crop-Livestock Integration and Conventional Planting) in the municipality of Jataí, Southwest of Goias. Nine sampling points information were collected for each handling system in three depth ranges (0 - 0.12 m, 0.12 to 0.24 m, 0.24 to 0.36 m). Bulk density and soil particle size (clay) were determinedaccording to the recommendation of Embrapa, 2009. Statistical analyzes were performed using analysis of variance and Pearson correction. The spatial variation was represented using the SURFER software. The results of variance analysis indicated statistical differences between values of density and soil granulometry for the different depths, the different managements and the spatial distribution within each management. It was perceived spatial relationship between moisture and attributes studied for some depths and types of management, but there was little influence of physical attributes in the behavior of moisture to the soil and conditions studied.
KEYWORDS: soil water content; pearson correlation; soil tillage systems.

RESPOSTA DA UMIDADE À VARIAÇÃO ESPACIAL DE ATRIBUTOS FÍSICOS EM DIFERENTES MANEJOS DE UM LATOSSOLO

RESUMO: Objetivou-se analisar a resposta da umidade à variação espacial da densidade e da granulometria em um LATOSSOLO VERMELHO Distroférrico sob três diferentes tipos de manejos (Plantio Direto, Integração Lavoura-Pecuária e Plantio Convencional) no município de Jataí, Sudoeste de Goiás. Utilizaram-se nove pontos de amostragem para cada sistema de manejo, em três intervalos de profundidade (0 - 0,12 m, 0,12 - 0,24 m, 0,24 - 0,36 m). Foram analisados os dados de densidade e granulometria do solo (argila) determinados em laboratório, segundo recomendação da EMBRAPA, 2009. Análises estatísticas foram realizadas por meio da análise de variância e da correção de Pearson. A variação espacial foi representada usando o software SURFER. Os resultados de análise de variância indicaram diferenças estatísticas entre valores de densidade e granulometria do solo para as diferentes profundidades, os diferentes manejos e na distribuição espacial dentro de cada manejo. Percebeu-se relação espacial entre umidade e os atributos estudados para algumas profundidades e tipos de manejo, porém houve pouca influência dos atributos físicos no comportamento da umidade para o solo e condições estudadas.

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PALAVRAS-CHAVES: conteúdo de água no solo, correlação de pearson; sistemas de manejo do solo.

INTRODUCTION

Water is the main factor determining the productivity of crops.During the whole development, the plant absorbs water and loses using the ground as a reservoir of water and nutrients. The amount of water consumed by a crop during its development varies with the spatial and temporal distribution of climate, the variety of culture and management of the agricultural system, which modifies the physical properties of the soil directly related to storage of water (Moreti et al., 2007).

Soil has higher variability in their attributes, both vertically and horizontally, resulting from the interaction of the processes that govern the factors of their formation (Carvalho et al., 2004). Knowledge of the distribution of physical water soil attributes becomes a basic requirement when seeking to establish appropriate management practices for soil and crops, for failure to comply with these concepts will result in errors in sampling and soil management. This stems from the large spatial variation of soil attributes and meaning and direction of water flows (Iqbal et al., 2005).

Therefore, the aim of this work was to analyze the response of moisture to the spatial variation of density and particle size in a Hapludox under three different managements (Tillage, Crop-Livestock Integration and Conventional Planting) in the municipality of Jataí, southwest of Goiás.

MATERIAL E METHODS

The experiment was conducted in an experimental area at the Federal University of Goiás (UFG) in Jataí City, in the southwest of the State of Goiás– Brazil. The experimental area was composed of three sub-areas of approximately 1 ha, cultivated with soybean (*Glycine max*) in the season 2013/2014 (first crop) with different soil management systems.

Subareas have been cultivated over the years with soybean in the first crop and maize (*Zea mays*) and sorghum (*Sorghum bicolor*) in the second (off-season) in no-tillage (NT) since the year 2008 (subarea 1) in crop-Livestock Integration system (ILP), consorting soybean crops and pasture since 2009 (subarea 2) and conventional tillage (CONV) associated with the use of harrowing at the time of planting. Each subfield is divided into a regular grid containing nine cells measuring 30 x 30 m each.

On predetermined points, it was collected the trash (crop residues deposited on the soil surface) using an arc with internal area of 1.0 m², released randomly near the sampling point. Immediately after sampling the straw at each point, it was made monitoring of soil moisture. Moisture data were collected on nine points on each soil management system (NT, ICL and CT) at depths from 0 to 0.12, from 0.12 to 0.24 and 0.24 to 0.36 m, between the months of November 2013 and February 2014, with instantaneous readings every 14 days, by means of an equipment type TDR (time domain reflectometry). At the same points, deformed samples were collected for determination of soil organic matter (SOM). Four repetitions were made within a radius of 1 meter from the reference point, collected randomly.

With the predetermined points, it was held to monitor the soil moisture, as well as the removal of undisturbed soil samples collected in containers volumes known for determining the density and deformed sample for determining of soil particle size (clay), as recommended Embrapa, 2009. This procedure was performed in nine points of each land management system and three different depths. The monitoring of soil moisture at depths from 0 to 0.12, 0.12 to 0.24 and 0.24 to 0.36 m, occurred with intermediate readings every 14 days, by means of equipment TDR (time domain reflectometry).

RESULTS AND DISCUSSION

Analyzing Table 1 and Figure 1, it is noted a tendency toward greater stability of density values along the soil profile in CT system, since the three layers of this system are equal to each other, while in other systems the first layers showed higher density values also represented by a greater homogeneity in color pattern between the three layers of CT system, compared to other systems.

Table 1. Organic matter content of the studied Latosol (Anova and test "Scott-Knott," α = 0.05, n = 9)

Items	Parâmeter	NT-A	NT-B	NT-C	ICL-A	ICL-B	ICL-C	CT-A	CT-B	CT-C
d (g cm^{-3})	Mean	1,26a	1,19b	1,17b	1,32a	1,22a	1,14b	1,24a	1,26a	1,27a
	Max	1,44	1,37	1,32	1,38	1,37	1,25	1,37	1,39	1,38
	Min	1,09	0,99	1,02	1,14	1,09	0,99	1,07	1,14	1,09
	σ	0,10	0,12	0,11	0,07	0,10	0,08	0,10	0,08	0,09
	CV	7,98	10,23	9,69	5,46	7,98	6,92	7,69	6,23	6,73
	Default E.	0,03	0,04	0,04	0,02	0,03	0,03	0,03	0,03	0,03
Clay (%)	Mean	45,1c	44,3c	48,2b	43,1c	46,8b	48,3b	57,6a	58,0a	58,9a
	Max	49,32	50,16	52,74	48,59	50,48	53,12	64,85	63,19	63,84
	Min	42,19	36,31	44,21	35,12	39,96	44,19	52,06	47,83	54,16
	σ	2,83	4,64	2,74	4,42	3,36	3,10	4,87	5,37	3,78
	CV	6,27	10,46	5,68	10,25	7,17	6,43	8,45	9,25	6,42
	Default E.	0,94	1,55	0,91	1,05	1,12	1,03	1,62	1,79	1,26

d = bulk density; σ = standard deviation; CV = coefficient of variation; Default E. = standard error of the mean; n = sample size; Means followed by the same letter on the line, do not differ statistically; NT: tillage; ICL: integrated crop livestock; CT: conventional tillage; A = 0 to 0.12; B = 0.12 to 0.24 m; C = 0.24 to 0.36 m

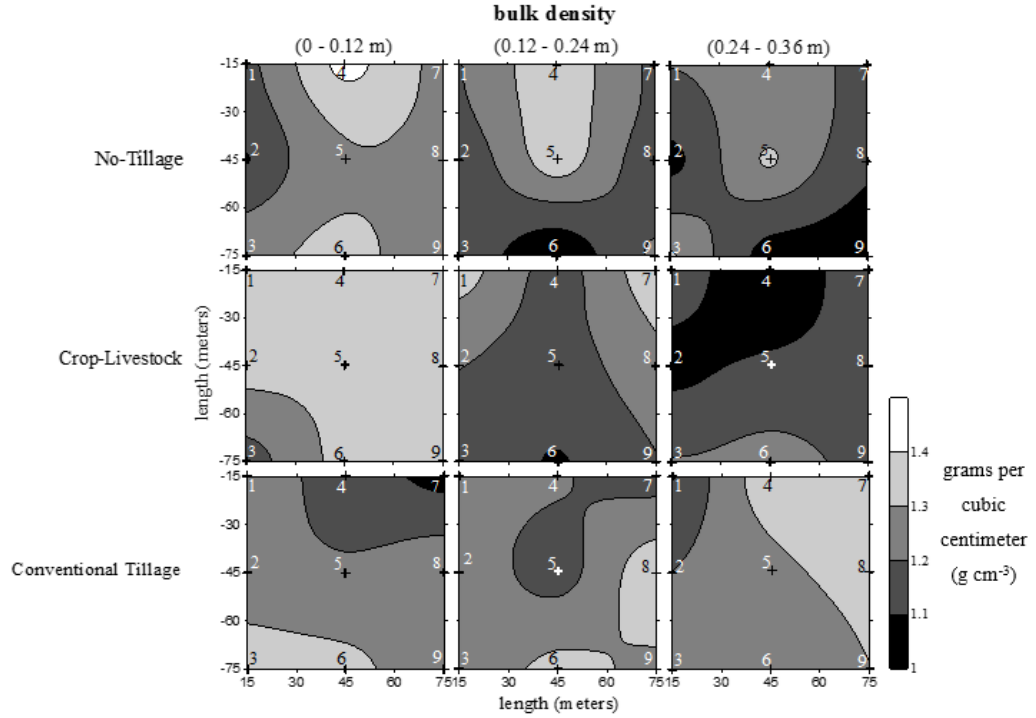

Figure1. Spatial distribution of density (g cm^{-3}) soil in three management systems and three depths.

The increased stability in CT probably occurred due to the frequent disturbance of the three depths under review. Higher values of soil density in layers close to the soil surface, in NT and ICL systems indicate a greater degree of compression in these layers (Table 1), which can be attributed to traffic historical of agricultural machinery in soil slightly upturned to over the years, confirming effects observed by Costa et al. (2003) and Assis et al. (2005). In ICL, such compaction becomes more pronounced due to animal trampling.

Similar to Gao & Shao (2012), the correlation coefficient of "Pearson" was used to examine the dependence of the water content in the soil (WCS) in relation to the soil properties to NT, ICL and CT at three different depths (Table 2).

Table 2. Correlation coeficiente of "Pearson" between soil moisture and variables investigated for the three types of management in different soil depths

Management System	Depth	Bulk Densidy	Clay
NT	A	0,29	- 0,14
	B	- 0,24	- 0,16
	C	- 0,23	0,22
ICL	A	- 0,14	- 0,20
	B	0,03	0,64**
	C	- 0,52**	- 0,16
CT	A	0,13	- 0,35
	B	- 0,35	- 0,56**
	C	- 0,79**	0,09

** Significant to 1% (ANOVA); A = 0 to 0.12 m; B = 0.12 to 0.24 m; C = 0.24 to 0.36 m; NT: no-tillage; ICL: integrated crop livestock; CT: conventional tillage.

The physical attributes analyzed showed spatial relationship with moisture in two soil management systems (ICL and CT), with two events in each system. The increase in density caused a reduction of soil moisture in depth from 0.24 to 0.36 m for both, ICL and to CT. However, to the clay, there was both a positive (ICL-B) and negative (CT-B) relation. Note also that greater depths favor greater influence of these attributes on the variation of soil moisture in ICL and CT systems (Table 2).

CONCLUSIONS

Although there was some significance between the analyzed variables, it can be considered that there was little influence of physical attributes in the behavior of moisture to the studied soil.

REFERENCES

ASSIS, R. L. de; LANÇAS, K. P. Avaliação dos atributos físicos de um Nitossolo vermelho distroférrico sob sistema plantio direto, preparo convencional e mata nativa. **Revista Brasileira de Ciência do Solo**, 29: 515-522, 2005.

CARVALHO, M. A. C. DE; SORATTO, R. P.; ATHAYDE, M. L. F.; ARF, O.; SÁ, M. E. de. Produtividade do milho em sucessão a adubos verdes no sistema de plantio direto e convencional. **Pesquisa Agropecuária Brasileira, Brasília**, v.39, n.1, p.47-53, 2004.

COSTA, F. S.; ALBUQUERQUE, J. A.; BAYER, C.; FONTOURA, S. M. V.; WOBETO, C. Propriedades físicas de um Latossolo Bruno afetadas pelos sistemas plantio direto e preparo convencional. **Revista Brasileira de Ciência do Solo**, 27: 527-535, 2003.

EMBRAPA – Empresa Brasileira de Pesquisa Agropecuária. **Sistema brasileiro de classificação de solos.** Rio de Janeiro: Centro Nacional de Pesquisa de Solos/Embrapa Solos, 412 p., 2009.

GAO, L.; SHAO, M. Temporal stability of shallow soil water content for three adjacent transects on a hillslope. **Agricultural Water Management** 110, 41-54. 2012.

IQBAL, J. et al. Relationships between soill and scape and dryland cotton lint yield. **Soil Science Society American Journal**, Madison, v.69, n.6, p.872-882, 2005.

MORETI, D.; LIBARDI, P. L.; ROCHA, G. C.; LOVATTI, M. J.; AGUIAR, L. I. G. Avaliação espaço-temporal das armazenagens gravimétrica e volumétrica da água num Latossolo com citros. **Revista Brasileira de Ciênciado solo**, v.31, p. 1281-1290, 2007.