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Spatial variation in soil penetration resistance according to the structural states of the soil and soybean crop yield

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The soil penetration resistance (PR) is used to identify and characterize soil layers densified by effects of tilling, and the results obtained are related to root growth and crop productivity. The aims of this work were: (i) to analyze the spatial variation in PR through resistance isolines in an Aquic Argiudoll with different long-term cropping sequences under no tillage (NT), (ii) to compare the information generated from the lines with the same PR values with the analysis of the cultural profile and (iii) to study the spatial variability in the PR and the bulk density (BD) in a 10-ha plot, and their relationship with soybean crop yield. An experiment was carried out in an Aquic Argiudoll in 100-m2 plots (4 m wide x 25 m long), with different long-term cropping sequences, under NT for 15 years. The treatments tested were: soybean and maize monocultures, wheat/soybean, wheat/soybean-maize and a permanent pasture as a reference. A digital penetrologger Eijkelkamp ® was used to take 20 measurements of the PR in each plot, through the design of a grid 5 m long and 0.66 m wide, centimeter-wise until 20 cm, totaling n= 400. In addition, an observation well (1 m wide by 30 cm deep) was analyzed by means of the technique of the cultural profiles. Besides, two sampling grids in a 10-ha plot with maize-wheat/soybean sequence were used to measure PR every 30 m and BD every 60 m. The variability in the soil properties was assessed using descriptive statistical analysis, determining normality and spatial variability with the adjustment to the theoretical semivariograms. At 10-15 and 15-20 cm, wheat/soybean-maize and wheat/soybean showed the highest PR values, differentiating from the soybeans and maize monocultures and pasture. The lines with the same PR values allowed observing structural changes in the soil profile, such as surface granular structures and subsequent layers of laminar structure, sometimes discontinuous, from 1.0 to 1.5 MPa between 5 and 8 cm in depth, and massive structures located in the profile up to 2.6 MPa. In the 10-ha plot, the PR identified a hardened layer at 05-12 cm, with a maximum value of 1.45 MPa; the PR also showed greater spatial variation in the plot than the BD, with maximum values of 2.58 MPa and 1.52 g cm-3, respectively. Although with varying thickness, platy structures were present in all the treatments of the crop sequences under NT. The identification of compaction areas at subsurface level, with reduction of macropores, coincided with the traffic. The crop sequences that presented high compaction were wheat/soybean and wheat/soybean-maize, attributable to the greater number of passes of agricultural machinery in the plot. We thus recommend controlled traffic. The results provide tools to identify areas for homogeneous soil management and detect constraints on soybean crop yield.