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Spatiotemporal variability of soil penetration resistance in a field cultivated with sugarcane under conventional tillage system in northeast Brazil

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Soil management, although intended to create favorable structural conditions for crop growth and development, without prior assessment of potential and limitations, has been one of the reasons for the degradation of natural resources. The effects on soil degradation and respective structural quality are generally evaluated by some physical soil attributes such as bulk density (BD), total porosity (TP) and soil penetration resistance (PR). The PR is recognized as a physical parameter that supports the identification of areas with different stages of compaction and thus can be used to define appropriate management for soil remediation. Besides, this parameter depends on intrinsic soil factors (texture, structure, and mineralogy) and soil water content (SWC). Therefore, PR increases with BD and decreases with SWC (gravimetric or volumetric). Thus, it is possible to establish the critical limit of PR (PR_{CL}) associated with the value of SWC that limits the growth of plant roots. PR_{CL} varies according to soil type and plant species, but 2.0 MPa is the value scientifically accepted as the critical value to limit the root growth. Thus, the paper aimed to evaluate the spatial and temporal variability of PR in a field cultivated with sugarcane, under the conventional tillage system. The research was carried out in the Carpina Sugarcane Experimental Station, Pernambuco, Brazil. A grid of 70 x 70 m was delineated at intervals of 10 m and in each point soil samples were collected in the layers 0 - 0.30 m and 0.30 - 0.60 m depth. Three samplings were done to determine gravimetric soil water content; the first after six months of subsoiling (Time 6) before harrowing and planting, the second after 12 months of subsoiling (Time 12, six months after harrowing and planting) and the last after 18 months of subsoiling, before harvesting (Time 18). In each sampling time, in situ PR tests were carried out with the Solo Track equipment (Falker® - Model PLG 5300) and the simultaneous values of gravimetric soil water content were determined and associated with the PR data. The results showed that soil water content had a weak degree of spatial dependence, indicating the need to increase the number of samples. On the other hand, the PR values showed that the subsoiling did not promote a positive effect on the soil physical quality, with values above the PR_{CL} for root development in Time 6 (2.42 MPa), even if after one year the sugarcane root system acted positively, by reducing PR in Time 18 (1.04 MPa)

below the critical value.