Relationships between Tillage Systems associated with Previous Crops and Effects on Corn Productivity in 14 years of Long-term Experiments in Northeastern Brazil

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The increase in corn production has been generated by increased physical productivity, caused especially by changes in technology and cultivation patterns. Moving from traditional techniques to the accession inputs of modern agriculture (Oliveira, 2011), the rapid growth in output raised corn production in Sergipe State from 6th position in 2003 to 2nd place in 2010 in the northeastern states of Brazil (IBGE, 2012).

Before the economic profitability and technological advances in the production process, corn had become one of the main sources of agricultural income in the Midwest Sergipana region, especially in areas surrounding the municipalities of Carira and Simão Dias. However, environmental and social issues also contributed (Santos, 2012).

In the northeast region of Brazil, long-term research studies and experiments that investigate the physical behavior of soils under different tillage systems associated with crop successions have been virtually nonexistent, especially with crops of great market potential, such as corn.

This study was performed fourteen years after the implementation of a long-term experiment, installed in 2001 at the Campus Rural Experimental Station of the Federal University of Sergipe - UFS, located in the central portion of the Coastal Plains (Table lands) physiographic region, in the municipality of São Cristovão - State of Sergipe, northeast Brazil (geographic coordinates 10°19' S and longitude 36°39' W), with an average elevation of 22 m above sea level. The soil at the experiment site is a typical dystrophic Red-Yellow Ultisol (Embrapa, 2006) and Typic Paleudults according to the Soil Taxonomy (USDA, 1999). The region has a climate classified by Köppen, of type As', tropical rainy season with dry summers and rainfall around 1400 mm per year, with rains concentrated in the period from April to September.

The physical parameters of soil were studied during the fourteen years of evaluation for the long-term plots with various treatments: conventional tillage system ("cultivo convencional") – CT (consisting of diskig + plowing + diskig ), minimum tillage ("cultivo mínimo") – MT (consisting of 1 or 2 diskings), and no-tillage or zero tillage ("plantio direto") – NT (consisting of no soil mobilization), and cultivation of various plants (including legumes) in crop succession to corn (Zea mays L.). Plants that were used in succession to produce corn (Zea mays L. – variety Biomatrix BM 3061) were sunflower (Helianthus annus), millet (Pennisetum americanum), pigeon pea (Cajanus cajan), and sunhemp (Crotalaria juncea).

The experimental design used was a split-plot strip block, with different soil management systems prepared in strips and different crop successions to corn in subplots, with three

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replications distributed randomly. In order to evaluate the soil physical parameters (soil density), soil mechanical resistance to penetration (RMP) was measured, and soil samples for chemical analysis (soil fertility and organic matter) were collected. For evaluation and statistical analysis of the physical parameters, the Tukey means comparison test was used at a significance level of 5% probability, using the statistical software program Sisvar (Furtado, 2003).

The no-tillage treatment resulted in greater values of RMP in the soil surface layers, although pigeon pea and sunhemp in the rotation had the smallest and greatest soil RMP values, respectively. Better sustainability conditions were observed for the no-tillage system related to the highest levels of crop productivity, greatest number of plants and plant spikes, and also the highest values of average soil particle mean weight diameters, and percentage of water-stable aggregates compared to the other systems. The no-tillage system was the one that provided the most important contributions to improving the soil physical properties. The rotations with sunhemp resulted in the best corn productivity in the conventional and minimum tillage systems. For the zero tillage system the rotation with beans provided the greatest corn productivity.

Plant residues left on the soil surface are important for soil quality, including improvement of soil microbiological activity and increased C/N ratio due to slow decomposition of straw and availability of nitrogen (Fageria and Stone, 2004). These benefits result in a suitable environment for food production in a sustainable way without compromising the agricultural activity.

Minimum tillage produced corn yields superior to conventional cultivation, indicating that the low soil disturbance combined with a high biomass culture can provide good productive results. From a financial point of view, no-till and minimum tillage systems also benefit farmers who cannot afford to plow soil conventionally.

References


Furtado, D.F. 2003. Sisvar, DEX/UFLA, Versão 4.6 (Build 62), Lavras, Brazil.


