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Effects of Tillage Practices on Soil Organic Carbon and Soil Respiration

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Soil tillage system and its intensity modify by direct and indirect action soil temperature, moisture, bulk density, porosity, penetration resistance and soil structural condition. Minimum tillage and no-tillage application reduce or completely eliminate the soil mobilization, due to this, soil is compacted in the first years of application. The degree of compaction is directly related to soil type and its state of degradation. All this physicochemical changes affect soil biology and soil respiration. Soil respiration leads to CO_2 emissions from soil to the atmosphere, in significant amounts for the global carbon cycle. Soil respiration is one measure of biological activity and decomposition. Soil capacity to produce CO_2 varies depending on soil, season, intensity and quality of agrotechnical tillage, soil water, cultivated plant and fertilizer.

Our research follows the effects of the three tillage systems: conventional system, minimum tillage and no-tillage on soil respiration and finally on soil organic carbon on rotation soybean – wheat - maize, obtained on an Argic Faeoziom from the Somes Plateau, Romania.

To quantify the change in soil respiration under different tillage practices, determinations were made for each crop in four vegetative stages (spring, 5-6 leaves, bean forming, harvest). Soil monitoring system of CO_2 and O_2 included gradient method, made by using a new generation of sensors capable of measuring CO_2 concentration in-situ and quasi-instantaneous in gaseous phase. At surface soil respiration is made by using ACE Automated Soil CO_2 Exchange System. These areas were was our research presents a medium multi annual temperature of 8.20C medium of multi annual rain drowns: 613 mm. The experimental variants chosen were: i). Conventional system: reversible plough (22-25 cm) + rotary grape (8-10 cm); ii). Minimum tillage system: paraplow (18-22 cm) + rotary grape (8-10 cm); iii). No-tillage. The experimental design was a split-plot design with three replications. In one variant the area of a plot was 300 m2.

Soil respiration varies throughout the year for all three crops of rotation, with a maximum in late spring (1383 to 2480 mmoli m-2s-1) and another in fall (2141 to 2350 mmoli m-2s-1). The determinations confirm the effect of soil tillage system on soil respiration; the daily average is lower at no-tillage (315-1914 mmoli m-2s-1), followed by minimum tillage (318-2395 mmoli m-2s-1) and is higher in the conventional tillage (321-2480 mmol m-2s-1). An exceeding amount of CO_2 produced in the soil and released into the atmosphere, resulting from aerobic processes of mineralization of organic matter (excessive loosening) is considered to be not only a way of increasing the CO_2 in the atmosphere, but also a loss of long-term soil fertility.

By determining the humus content after 3 years, it can be observed an increasing tendency when applying the minimum tillage (the increase was up to 0.41%) and no-tillage systems tillage (the increase was up to 0.64%). Carbon sequestration in soil is net advantageous, improving the productivity and sustainability. The more the organic content in soil is higher the better soil aggregation is. The soil without organic content is compact. This reduces its capacity to infiltrate water, nutrients solubility and productivity, and that way it reduces the soil capacity for carbon sequestration.

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