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Interrelations between precipitation and fertilization on soil organic carbon changes

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Soil conditions, particularly moisture, fertilization, tillage and cropping management, all have important impacts on organic carbon (SOC) dynamics. Changes in modern agricultural management practices can potentially modify strongly it's accumulation rate in soils. Long-term fertilization (N, P2O5, K2O, CaO, MgO), and rainfall (quantity, distribution) effects on SOC changes of a Haplic Luvisol (sandy acidic lessivated brown forest soil) in a long term field experiment with different indicator crops [rye (Secale cereale L.), potato (Solanum tuberosum L.), winter wheat (Triticum aestivum L.), lupin (Lupinus albus L.), sunflower (Helianthus annuus L.), grass, barley (Hordeum vulgare L.), tobacco (Nicotiana tabacum L.), triticale (X Triticosecale W.)] were studied in a fragile agro-ecological environment at Nyírlugos (Nyírség region of Eastern Hungary) from 1962 to 2002 for 40 years. The soil had the following agrochemical characteristics: pH (H2O) 5.9, pH (KCl) 4.7, hydrolytic acidity 8.4, hy1 0.3, humus 0.7%, total N 34 mg . kg-1, ammonium lactate (AL) soluble-P2O5 43 mg . kg-1, AL-K2O 60 mg . kg-1 in the plowed layer. From 1962 to 1980 the experiment consisted of 2x16x4x4=512 plots and from 1980 of 32x4=128 plots in split-split-plot and factorial random block designs. The gross plot size was 10x5=50 m2. Average fertilizer rates in kg . ha-1 . year-1 were: nitrogen 45, phosphorus 24 (P2O5), potassium 40 (K2O), magnesium 7.5 (MgO) until 1980 and nitrogen 75, phosphorus 90 (P2O5), potassium 90 (K2O), calcium 437.5 (CaCO3), magnesium 140 (MgCO3) kg . ha-1 . year-1 after 1980. In 1963, 1973, 1983, 1988, 1998 and 2002 soil samples were collected (0- to 20-cm depth consisting of 20 sub-samples) from the field treatments. SOC content was measured by dichromate oxidation using the HR-080452-80 protocol by Baranyai 1987. Precipitation data were collected from Napkor Meteorological Station

at Napkor. Main results and conclusions are as follows: in trial plots, the SOC pool significantly (P< 0.05) decreased (control: 10.1%; N: 31.0%; NP: 11.9%; NK: 13.7%; NPK: 11.9%; NPKCa: 13.7%; NPKMg: 22.3%; NPKCaMg: 13.7%) from 1963 to 1982. Conversely, after 20-yr (from 1983 to 2002) the SOC stock increased (control: 1.3%; N: 12.2%; NP: 24.9%; NK: 17.4; NPK: 27.2%; NPKCa: 16.3%; NPKMg: 20.8%; NPKCaMg: 15.1%). In untreated plots, SOC concentration remained nearly constant over the whole 40 year period. Fertilization in comparison with control significantly (P< 0.05) increased SOC (N: 3.02%; NP: 11.2%; NK: 6.9%; NPK: 13.9%; NPKCa: 6.3%; NPKMg: 6.3%; NPKCaMg: 5.1%). SOC stores in soils decreased linearly by increasing rainfall (477 to 572 mm . yr-1).

Key words: climate, water, fertilization, SOC