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Conservation farming is a promising way for providing the prolonged mitigation of climate change

Valentin Lopes de Gerenyu (1), Dmitry Khoroshaev (1,2), Sergej Ustyak (3), and Irina Kurganova (1)

(1) Institute of Physicochemical and Biological Problems in Soil Science of the Russian Academy of Sciences, Laboratory of Soil Cicles of Nitrogen and Carbon, Pushchino, Russian Federation, (2) Pushchino State Institute of Natural Sciences, Pushchino, Russian Federation, (3) Crop Research Institute, Prague, Czech Republic

The use of conservation farming has both economic and ecological benefits compared with the conventional system of agriculture. Today, No-till technology is the most promising way for preservation of soil organic carbon (SOC) and prolonged mitigation of climate change. Exclusion of plowing and conservation of plant residues on the soil surface leads to conservation and more intensive recovery of soil fertility, reduction of wind and water erosion, increase of crop yields. This study was aimed to investigate the effect of various tillage systems on SOC and total N content, C-mineralization rate, labile (Clab), recalcitrant (Crec), and microbial carbon (Cmic) content under various climates: temperate semi-arid (Prague, Czech Republic) and continental arid (Orenburg, Russia).

The field experiment in Czech Republic (Crop Research Institute, clay-loamy Orthic Luvisols) has been running from 1995 and established the rotation of 3 crops: winter wheat, spring barley, and white mustard. Three treatments (tillage methods) were set-up: (1) conventional tillage, CT; (2) no-tillage, NT; (3) no tillage + mulch (NTM). Each tillage treatment included 2 variants of mineral N fertilization – 50 and 150 kg N per ha. In Orenburg region, the field experiment has been running from 1992 (Orenburg State Agrarian University, loamy Calcic Chernozems) and established the rotation of cereal crops. Five treatments were foreseen: (1) CT, (2) subsurface tillage, ST; (3) minimal tillage, MT; (4) minimal tillage+ploughing, MT-P; (5) no-tillage+ploughing, NT-P. Soil samples were collected from 0-10 cm (in Orenburg) and 0-20 cm (in Praque). Content of SOC and total N, C-mineralization rate, labile (Clab) and recalcitrant (Crec) pools of carbon, and microbial carbon (Cmic) were determined in mixed soil samples (3 replications).

Conservation systems resulted in increase in SOC and N content in topsoils by 5-18% and 9-30% in semi-arid and arid climate, respectively. In both experiments, Cmic content under conservation technology was 1.5-3 times higher in comparison with conventional system. Due to higher microbial activity in soils under conservation farming, the rate of C-mineralization was the highest under NT-M (Orthic Luvisols) and NT-P (Calcic Chernozems). The NT treatment indicated the most significant influence on the soil carbon pools and N content while the effect of N-application rate was not revealed. We observed a clear tendency of increasing of the recalcitrant fraction in total organic carbon pool under the conservation tillage for both soils studied. A close positive correlation ($r>0.94$; $P<0.05$) between the total loss of C-CO_2 (Ccum), SOC, and Cmic content were revealed in both field experiments.

We can conclude that all conservation technologies improved the quality of soil and led to accumulation of organic matter. The NT treatment indicated most significant influence on the soil carbon pools and N content while the effect of N-application rate was not observed. Conservation farming should be recommended for use in both regions studied to prolong the mitigation of climate change.

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