Geophysical Research Abstracts, Vol. 9, 00882, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-00882

Evaluating relative Contribution of microbial Decomposition and Erosion in Degradation of Soil Organic Matter after 18 Years of agricultural Use of Soils in North Kazakhstan

A. Mamilov (1)**,** C. Knoblauch (2), E.-M. Pfeiffer (2), Oliver Dilly (3)

(1) Institute of Soil Science, Soil Microbiology Group, Akademgorodok, Al-Farabi 75B, 050065 Almaty, Kazakhstan (mamilov@nursat.kz), (2) Institut für Bodenkunde, Universität Hamburg, Allende-Platz 2, 20146 Hamburg, Germany, (3) Lehrstuhl fur Bodenschutz und Rekultivierung, Brandenburgische Technische Universitat

Postfach 101344, 03013 Cottbus, Germany (dilly@tu-cottbus.de)

Steppe ecosystems store significant amounts of the global carbon and were largely transformed to agricultural systems. At an experimental farm in Kazakhstan, the use of virgin soils for agricultural production reduced soil organic C contents from 4.9 to 2.9 % in upper soil horizons. Such high C losses by agricultural management contribute significantly to the increase in carbon dioxide concentrations in the atmosphere. Elevated microbial decomposition of soil organic matter is assumed to cause carbon losses from soil. However, wind and water erosion induced by tillage may also be important factor controlling soil degradation. Intensive dust storms accompanying first years of agricultural use in Kazakhstan constrained to adopt conservation tillage practices. Here, we considered ^{13}C signatures for the evaluation of biological transformation of soil organic matter and specific microbial decomposition versus in-specific wind and water erosion in degradation of soil organic matter.

The following tillage practices applied in northern Kazakhstan since 1986 were considered in the study: Mould-board ploughing (MBP) with ploughing depth 20-22 cm; conservation tillage (CT20) with ploughing depth 20-22 cm; (iii) CT10 with ploughing horizon 10-12 cm and virgin soil (VS).

Microbial biomass estimated by fumigation-extraction (FE) and substrate-induced respiration (SIR) together with soil respiration were measured during experiments and microbial eco-physiological quotients were calculated. Isotopic signature of soil C and respired CO_2-C were determined after precipitation by mass spectrometry.

After 18 years of cultivation total microbial biomass and respiration rate were lower in tilled soils. Metabolic responsive component of total microbial biomass estimated by SIR/FE ratio and metabolic quotient referring to carbon use efficiency were higher in MBP then in VS. Thus, physiological state of microbial community and conservation of soil organic matter are closely related. The δ^{13}C signature of soil organic matter in VS was –26.1 ‰ and was significantly lower in tilled soils and varied between –20.5 and –21.8 ‰. The δ^{13}C signature of respired CO_2-C during basal respiration was closely related to δ^{13}C data of soil organic matter. The ^{13}C enrichment in organic matter of tilled soils suggests that (i) soil organic matter was lost during cultivation by microbial decomposition and (ii) new input by C4 plants may have been sequestered but soil organic matter seems not to be in-specifically dislocated to other ecosystems by erosion.