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Impact of different tillage treatments on soil respiration and microbial activity for different agricultural used soils in Austria

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Soils can act as a net sink for sequestering carbon and thus attenuating the increase in atmospheric carbon dioxide if appropriate soil and crop management is applied. Adapted soil management strategies like less intensive or even no tillage treatments may result in slower mineralization of soil organic carbon and enhanced carbon sequestration. In order to assess the impact of different soil tillage systems on carbon dioxide emissions due to soil respiration and on soil biological activity parameters, a field study of three years duration (2007-2010)has been performed at different sites in Austria. Following tillage treatments were compared: 1) conventional tillage (CT) with plough with and without cover crop during winter period, 2) reduced tillage (RT) with cultivator with cover crop, and 3) no-till (NT) with cover crop. Each treatment was replicated three times.

At two sites with similar climatic conditions but different soil textures soil CO_2 efflux was measured during the growing seasons in intervals of one to two weeks using a portable soil respiration system consisting of a soil respiration chamber attached to an infrared gas analyzer. Additionally, concurrent soil temperature and soil water contents of the top layer (0-5 cm)were measured. For these and additional three other sites with different soil and climatic conditions soil samples were taken to assess the impact of tillage treatment on soil biological activity parameters. In spring, summer and autumn samples were taken from each plot at the soil depth of 0-10, 10-20, and 20-30 cm to analyze soil microbial respiration (MR), substrate induced respiration (SIR), beta-glucasidase activity (GLU) and dehydrogenase (BHY). Samples were sieved (2 mm) and stored at 4 °C in a refrigerator. Analyses of were performed within one month after sampling.

The measurements show a high spatial variability of soil respiration data even within one plot. Nevertheless, the level of soil carbon dioxide efflux was similar for CT and RT, but usually higher than for NT. Minimum values occurred under cold and dry, maximum values under hot and moist conditions. Focusing on the soil texture, higher fluxes were observed for sandy silt thank for loamy clay. During the investigated growing seasons carbon releases from the sandy silt ranged between 7.0 and 11.1, 6.6 and 10.4, and 5.4 and 8.4 t CO_2-C.ha-1 for CT, RT and NT, respectively. Corresponding values for the loamy clay ranged from 2.8-7.0, 3.4-7.4, and 4.7-6.6 t CO_2-C.ha-1 for CT, RT and NT, respectively. Microbial activity at 0-10 cm depth differed significantly between the five investigated sites. SIR and DHY showed significantly higher values in spring and summer, respectively, than in other seasons. The impact of tillage is demonstrated by significantly higher values of all investigated biological activity parameters for RT and NT.