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Five years of soil respiration measurements in two contrasting tillage treatments of a long-term field experiment

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In this study we attempted to address the hypothesis that the applied tillage management influences CO_2 emission (soil respiration, Rs) from agricultural soils. To retrieve as robust and general results as possible we selected a long term soil quality versus climate experiment of the Józsefmajor Experimental and Training Farm (JETF) of the Szent István University, where six different tillage methods had been applied systematically for 12 years at the initiation of our measurements of soil respiration in 2013. The site is under crop rotation, leading to annually changing and non-repetitive vegetation presence during the course of the observation period in this case. The cultivated crops include summer (barley, maize, sunflower) and winter crops (wheat, oat). An excessive period of five years data on regular manual static chamber measurements of Rs and its abiotic drivers are presented in this study in two contrasting tillage treatments: no-tillage and mouldboard ploughing. Gas samples were collected throughout the whole year, approximately weekly in the growing season. We found that soil respiration was significantly higher in the no-till treatment in the observation period (mean Rs in NT was 0.1 $mg\ CO_2\ m^{-2}\ s^{-1}$ versus 0.09 $mg\ CO_2\ m^{-2}\ s^{-1}$ in MP; $p < 0.01$), and the difference was larger in the growing season. This result is independent of crop type but when examining years separately, winter crop years showed smaller difference. Abiotic drivers of Rs showed no difference in case of soil temperature, but we found differences in soil water content, which was higher in NT in some periods probably due to effect of surface cover. Soil temperature turned out to be the major abiotic driver on the long term as a result of the interaction of annual temperature course and vegetation status (for the entire study period soil temperature explained 34 and 41.6% of the explained variance in in NT and MP, respectively). Soil water content explained less variability in Rs data in case of the chernozem soil of the site. Soil properties also differed between treatments, e.g. soil organic carbon amount in its vertical distribution.