



## Effect of drought stress on summer CO<sub>2</sub> fluxes from grassland and bare plots under temperate continental climate

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

(1) Institute of Physicochemical and Biological Problems in Soil Science of the Russian Academy of Sciences, Laboratory of Soil Cycles of Nitrogen and Carbon, Pushchino, Russian Federation (d.khoroshaev@tutanota.com), (2) Pushchino State Institute of Natural Sciences, Pushchino, Russian Federation

Climate changes occurring in most parts of the territory of Russian Federation show distinct trends of rising air temperature and increasing aridity. The frequency of summer droughts in Central Russia increased during the last decades. The total soil respiration (TSR) reacts to drought stress and can reflect both the current state of the climate in the region and response to long-lasting changes in the hydrothermal regime. The sensitivity of the microbial and root respiration is different and may be changed in different regions, ecosystems and timescales. The study was aimed to evaluate the effect of drought stress on summer CO<sub>2</sub> fluxes from grassland and bare plots under temperate continental climate.

To simulate long and short droughts, the manipulation precipitation experiment was established in grassland cenosis and bare plots (Luvisols Haplic, Moscow region, 54°50'N, 37°36'E). During the warm period (May–October), the following precipitation patterns were foreseen: RM — regular moistening with irrigation 2–3 times per week to maintain the volumetric water content in the soils at 25–30% on the grass plots and 17–20% in the fallow (corresponding to 60–70% of the water holding capacity); SD — two short-term (alternating) droughts that were modelled in early summer (June–July) and late summer (August–September); LD — long-term summer drought lasting 94 days (rainfall was absent from June to September). CO<sub>2</sub> emission rate (R-CO<sub>2</sub>) was measured by closed chamber method 2–3 times per week (and every day during rewetting after drought) by Li-COR 6400 system.

For the grassy plots the total losses of carbon as C over the whole period studied were approximately equal in the RM and SD variants and amounted to 1130±157 and 1186±57 g C/m<sup>2</sup>, respectively. In the LD variant, the losses of C-CO<sub>2</sub> over the same period were almost two times lower – 644±67 g C/m<sup>2</sup>. In the bare plots, the total C-CO<sub>2</sub> emission was approximately the same in the RM and LD variants and amounted to 150±9 and 140±0.3 g C/m<sup>2</sup>, respectively. In the SD variant, the total C-CO<sub>2</sub> fluxes were 1.3–1.4 times higher and averaged 192±7 g C/m<sup>2</sup>. At the end of the severe drought, three hours after irrigation, the R-CO<sub>2</sub> from the soil of the grass plots in the SD variant increased from 246±77 to 451±90 mg C/m<sup>2</sup>/h and from 50±3 to 107±9 mg C/m<sup>2</sup>/h on bare plots.

We conclude that under continental temperate climate, summer TSR is regulated mainly by severe summer droughts, while the impact of repeated droughts was weaker due to the Birch' effect. Soil respiration of grassland was more sensitive to drought stress than that of bare plots. In general, TSR decreased by 43% under severe drought stress which may be a result of plants and root-deriving microbial community inhibition by water deficit.

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