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Influence of contrast morphogenetic features of urban constructed soils on the functioning of Moscow green lawn urban ecosystems: analysis based on the field model experiment

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Green lawns are the key element of the urban environment. They occupy a considerable part of the city area and locate in different urban functional zones. Urban constructed soils under green lawns have a unique spatial variability in chemical and morphogenetic features. So far, there is lack of information on the influence of morphogenetic features of urban soils on the functioning of the green lawn ecosystems especially in Moscow – the biggest megalopolis in Europe.
Urban lawns perform a number of principal functions including both aesthetic and environmental. The role of the green lawn ecosystems in global carbon cycle is one of their main environmental functions. It is traditionally assessed through carbon stocks and fluxes in the basic ecosystem components. So far, such a data for the urban lawn ecosystems of the Moscow megapolis is lacking. In addition to environmental functions, green lawns perform an important ornamental role, which is also a critical criterion of their optimal functioning. Considering the variability of driving factors, influencing green lawns in urban environment, we carry out the model experiment in order to analyze "pure" effect of soil morphogenetic features. The current study aimed to analyze the influence of contrast morphogenetic features of urban constructed soils on the environmental and aesthetic functions of lawn ecosystems in Moscow megapolis basing in the model experiment.
We carry out the model experiment located at the experimental field of the Russian State Agrarian University. Special transparent containers developed for the experiment, provided an option to observe soil morphogenetic features dynamics, including the depth and material of the organic transformation. At the same soil body inside the containers was united with the outside environment through the system of holes in the bottom and walls.
The set of urban constructed soils includ four contrast types of the top soil (turf (T), turf-sand (TSa), turf-soil (TSo) and sand-soil (SS)) with three version of the depths (5, 10 and 20 cm). Soil construction with 10 cm organic horizon from TS top soil was taken as a reference. Grass mixture used for the green lawn including: Lolium perenne, Poa pratensis and Festuca rubra. For all the containers we measured soil CO_2 emission by Li-820, soil temperature and moisture and the grass ornamental quality based on the 30-score scale (Laptev; 1988). All the measurements have been done in June-October 2013 with two-week time steps. We also observed the dynamic in soil chemical features (Corg, Ntot and pHKCl) monthly.
We found high seasonal dynamics for all the observed functioning parameters. The highest CO_2 emission was obtained in the beginning of July, whereas the lowest one – at the end of August. Maximal averaged CO_2 emission was shown for the TSa and TSo substrates with the 20 cm depth. The lowest flux has been fixed for the more mineralized substrat. Soil moisture was shown as the main driving factor influencing CO_2 emission both for the seasonal dynamics and for the averaged values for different substrates and depths ($r=0.5$, $p<0.05$).
As for the aesthetic function the highest grass ornamental quality was shown for 20 cm TS and 5 cm T substrate (30 scores), whereas the lowest one was obtained for SS substrate with 5 and 20 cm depths (5 scores). We also obtained high positive correlation between the grass ornamental quality and the CO_2 emissions ($r=0.84$, $p>0.05$). This outcome highlights that the standards of urban constructed soils' optimal features should be the compromise between the beauty of the green lawn and climate mitigation demands.
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