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Can management improve the lawn's functioning in the conditions of multiple anthropogenic stressors?

Olga Gavrichkova[1], Dario Liberati[2], Viktoriya Varyushkina[2,3], Kristina Ivashchenko[3,4], Paolo De Angelis[2], and Viacheslav Vasenev[3]

[1]Research Institute on Terrestrial Ecosystems, National Research Council , Porano, Italy (olga.gavrichkova@cnr.it)
[2]Department for Innovation in Biological, Agro-food and Forest Systems, University of Tuscia, Viterbo, Italy
[3]Agro-Technology Institute, Peoples Friendship University of Russia, Moscow, Russia
[4]Institute of Physicochemical and Biological Problems in Soil Science, Russian Academy of Sciences, Pushchino, Moscow region, Russia

Release of heavy metals, salts and other toxic agents in the environment is of increasing concern in urban areas. Contaminants not solely decline the quality of the local environment and affect the health of human population and urban ecosystems but are also spread through runoff and leaching into non-contaminated areas. Urban lawns are the most distributed green infrastructure in the cities. Management of lawn system may either exacerbate the negative effects of contaminants on lawn functioning either help to withstand the toxic effects and maintain the lawn ecosystem health and the efficient release of ecosystem services.

The aim of this study was to evaluate the interactions between the lawn management, the lawn functioning, and the release into the soil of typical urban contaminants. For this purpose, *Festuca arundinacea* grass was planted in a turf-sand mixture with and without amendment addition (zeolite + vermicompost). To reproduce the impact of traffic-related contaminants in proximity of the road, pots were treated with a solution containing de-icing salt (NaCl) and 6 heavy metals (Zn, Cd, Pb, Cr, Cu, Ni), imitating road runoff solution. After contamination, half of pots was maintained at optimum soil water content (Smart irrigation), another half was left to periodical drying in order to simulate conditions with discontinuous watering (Periodical irrigation). The same experimental scheme was reproduced for unplanted soil. CO_2 net ecosystem exchange (NEE), soil and ecosystem respiration as well as flux from unplanted soil (heterotrophic respiration) were measured shortly after the treatment (short-term) and up 3 months since the treatment start (long-term).

Soil amendment stimulated plant productivity and increased the efficiency of the system in C uptake (+56% NEE). A relevant reduction of NEE was observed from 14 to 40 days after the application of traffic-related contaminants in both amended and non amended pots. During this period the contaminants had the greatest impact on lawn NEE subjected to Periodic irrigation (-49% and -66% in amended and non amended pots, respectively), while lawn under Smart irrigation was less affected (-35% and -26% in amended and non amended pots, respectively). Different respiration sources (ecosystem respiration, soil respiration, heterotrophic respiration)

were characterized by different sensitivity to management and contamination. Heterotrophic flux was not sensitive to soil amending but declined with contamination with enhanced negative effect under Smart irrigation. Response of ecosystem respiration to contamination was less pronounced in confront to soil respiration suggesting leaf-level buffering.

Three months later, the effect of contaminants on lawn gas exchange ceased for all treated pots. Instead, the irrigation effect persisted depending on whether pots were amended or not. In non amended pots NEE was reduced by 18% under Periodic irrigation, while this effect was not present in amended pots. We conclude, that performance of such green infrastructure as lawns in terms of C sequestration under multiple anthropogenic stressors could be efficiently improved through soil amending and irrigation control.

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