Resistance and resilience of soil N cycle-related bacterial processes to drought and heat stress in rehabilitated urban soils.

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In the context of global change, drought and heat periods may alter biogeochemical cycles of major elements in terrestrial ecosystems, including the N cycle. The aim of this study was to evaluate the resistance and resilience of restored urban soils' functions related to N cycling. A laboratory experiment was conducted in microcosms with four soil-types collected from a rehabilitated brownfield; an initial soil (IS), a Technosol with a high organic matter level (HO) and two Technosols with less organic matter (LO1 and LO2). Changes in potential denitrification (PDR), nitrification and N-mineralization rates and their interactive relationships with soil microbial activity and diversity, together with soil physicochemical properties were examined for 3 months following a heat (40°C) and drought stress period of 21 days. Immediately after the stress, the PDR decreased significantly for all soils compared to their respective controls (no stress), which demonstrates an impact of the stress on the resistance of denitrifying microorganisms for all soils. HO was the most resistant to stress as showed by significantly higher PDR than for LO1 and LO2. Five days after stopping the stress, all soils had recovered their PDR activity. Similar results were obtained after 30 days, indicating a quick recovery of PDRs and therefore a good resilience of the PDR on short and medium term. However, 92 days after stress, LO1 and LO2 PDR were still significantly lower than their controls, which indicates an incomplete resilience on the long term for these two soils. Additionally, the evolution of several indicators of soil microbial activity, *i.e.* basal respiration (BR), enzymatic activities and carbon metabolism profiles, were monitored along the experiment. LO1 and LO2 treatments' basal respiration was impacted by the stress, as their BRs were significantly lower than their controls; HO's BR was found to be the highest and no difference was found between IS and its control at the end of the stress. At the end of the experiment (92 days) LO1 and LO2 recovered and their BRs reached the same order of activity as the controls. Last, abundance of functional genes of the N cycle (*amo*A, *nar*G, *nir*K, *nir*S and *nos*Z) were assessed using qPCR. Just after the stress, no significant differences were found

between treatments and controls, suggesting no effect of stress on genes abundances. HO had the highest *nar*G and *amo*A genes abundances compared to other treatments, as well as the highest basal respiration, suggesting a higher microbial activity and a more pronounced denitrification capacity. The correlations between functional genes and nitrification, denitrification processes will be investigated, to highlight relationships between functional diversity and soil functions. Measuring the resistance and resilience of soil functions can help design choose the best ecological restoration trajectory.