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Factors or Actors? Influence of rain, freeze-thaw and vegetation on the pedogenesis of green roof's substrates.

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Abstract

The substrate of a green roof is characterised by its intrinsic properties that condition the hydrological and thermal performance of the green roof. Due to its position on the roof of the building and its nature as a Technosol, the green roof is disconnected from natural regulation networks. However, its exposure to climatic agents (e.g. rain, temperature, wind, solar radiation) and vegetation cover is substantially high. It is therefore likely to evolve more rapidly through early pedogenesis.

The objective of this study was to improve knowledge on the evolution of bio-physico-chemical properties of different green roof substrates over time, under the influence of three main factors (rain, temperature, vegetation). It has been studied through a controlled conditions experiment by reproducing the designated factors in mesocosms. The evolution of properties has been studied at four time steps: initial, after 2 weeks, 4 weeks and 8 weeks. Three contrast commercial green roof substrates (P, I, X) with different compositions were studied under the influence of four factor modalities (*i.e.* rain simulation, freeze-thaw simulation, vegetation simulation and a reference modality). For each substrate-factor association, 3 replicates were created in order to have statistically accurate results. A total of 108 mesocosms were created (3 substrates x 4 modalities x 3 replicates x 3 time period). The substrate properties were measured over different time periods.

Our results showed evidence of early pedogenesis especially for the finer substrate (P). Depending on the substrate: i) vegetation stimulates or maintains microbiology; ii) rain modifies granulometry through leaching processes; iii) frost modifies granulometry through fractionation. There was also change in the poral structure thus modifying the water retention performance. Other than that, the changes in the performance of other studied properties seem more due to the temporal evolution rather than factorial based. It was also noted in monitoring of the reference samples which revealed: a decrease or increase in pH depending on the substrate, small variations in microbiology and in organic carbon and total nitrogen concentrations. This proves that an intrinsic biotic vector intervenes in the evolution of the green roof.