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Agronomic evaluation of green roof growing media based on recycled polyurethane foam

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The greening of urban spaces is a potential lever for reducing greenhouse gas emissions and carbon sequestration (European Green Deal, 2021). Green roofings are is one specific type of vegetated urban ecosystems involving physicochemical constraints has been globally increasing during recent years in term of number and surface areas. Green roof ecosystems are expected to provide a range of urban ecosystem services, e.g. microclimate regulation, air quality improvement, stormwater retention, habitat for flora and fauna, and aesthetic values.

Polyurethane (PU) is a polymer-based material produced from the reaction of polyols and isocyanates, a chemical process pioneered in 1937 in Germany. This polymer is very different from other plastic materials. It can be incorporated in different products, such as paint, liquid coating, elastomers, insulation, elastic fibers, foams, etc. In France, the annual production of PU is estimated at 250 kt in 2011 mostly produced as foam (PUF) and only 3 kt are recycled each year. We are therefore looking for ways to valorize these PU. Among these, the agronomic valorization of these materials in planting supports is questioned. PU foams are characterized by a very low density (on average between 20 and 30 $kg.m^{-3}$), and could be added to lighten growing media (GM) for green roofs for example. The objective of this work is to evaluate the ability of different PU-GM to promote plant growth. For this purpose, an 18-month in situ experiment was conducted in order to observe the development of 4 ornamental plant species (*Lolium perenne*, *Euphorbia*, *Hypericum* and *Stipa*) on 3 GM formulations made of compost, PU foam and arable soil.

The results of the study showed that the 3 GM were suitable for plant growth. Among them, the mix of 20% of soil and 80% vol. of the compost-PUF mixture (60%and 40%, respectively) presented the best plant biomasses, due to a better nutrient availability. The main consequence of increasing PUF content in these GMs was a dilution of the nutrient content, and thus a decrease in biomass produced. Other agronomic properties (available water, bulk density and macroporosity) did not have a significant impact. The lixiviates were particularly concentrated in macro / oligo nutrient and metallic trace metals at the beginning of the experiment, due to the high initial levels of macro and trace elements, but the concentrations became almost zero after 6 months of experimentation. However, while these fertility trials of foam mixtures look promising in the short term, the biodegradation of PU, which is admittedly very slow, and the potentially hazardous compounds released to the environment need to be investigated.