Healthy Plants vs Efficient Living Wall: Laboratory experiment and data analysis

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Lieve Dierckx & Dr. Franziska Opitz & Emily Jäger

Vegetation and fauna on biodiverse green roofs - Basel and Berlin

Urban growth and densification are leading causes of natural habitat losses and a decline in biodiversity. Extensive green roofs can provide refuge for species adapted to extreme site conditions and serve as habitat and stepping stones for the survival of even endangered plants and animals. Furthermore, it is becoming increasingly important to combine photovoltaics and extensive green roofs to generate renewable energy while creating suitable habitats.

Recent vegetation analyses in Basel and Berlin on several extensive green roofs with and without photovoltaics and different habitat types, e.g., 27 habitats in Basel alone, have shown that habitat diversity and substrate heterogeneity of extensive green roofs increase the biodiversity of plant communities, including endangered plant species. On extensive green roofs, approximately 200 vascular plant species per city were recorded, with large differences in the number of species per roof. In Basel, the number of plant species was ranging from, only two plant species per 10m2-Plot on a roof with low substrate height and no habitat heterogeneity, to a maximum of 40 species per 10m²-Plot on a structurally rich, substrate-heterogeneous roof. When combined with substrate heterogeneity, elevated photovoltaic installations can create additional microhabitats on extensive green roofs (see picture).

In addition, habitat-rich and substrate-heterogenous roofs increase arthropod diversity, which in turn can serve as food source for higher trophic levels.

When designing a biodiverse extensive green roof (with and without photovoltaics), it is important to consider that substrate heterogeneity and structural richness are essential. Extensive and professional maintenance and the use of local plants adapted to the extreme roof conditions are vital to establish a dynamic self-sustaining vegetation while at the same time making full use of regenerative energy production. Therefore, we recommend promoting heterogenous extensive green roofs as a diverse habitat for flora and fauna.

Figure 1: Roof of the shopping centre Stücki, Basel, Switzerland. Plant species rich extensive green roof with photovoltaic installation. Copyright: L. Dierckx

Laura Dominici

Healthy Plants vs Efficient Living Wall: Laboratory experiment and data analysis

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Living walls are increasingly adopted as green infrastructures to reintroduce nature in built environment and provide benefits in addition to aesthetic amelioration such as the improvement of air quality or the increase of biodiversity. As for other nature-based solutions, living walls are complex systems in which vegetation plays a pivotal role in the mitigation of adverse conditions. Indeed, the efficiency and the aesthetic appearance of these plant-based strategies strictly depend by the health status of plants used to build the living wall itself. Substrate play a pivotal role on plant health and growth along with environmental conditions, such as light exposure, temperature and humidity. However, sustainability features of substrate are often overlooked, and non-renewable materials are frequently used to produce growing media for living walls. Therefore, this study presents and discusses results obtained during a 120-days laboratory experiment concerning the effects of some innovative growing media on health and growth status of plants commonly used for vertical greening. These innovative growing media were produced by upcycling some organic waste and by-products collected from local supply chain such as cork obtained by stoppers, raw wool, hazelnut shells, hemp stalks, fronds of invasive freshwater vegetation, and coffee grounds. Each waste and by-product have been mixed with regular soil used for the cultivation of ornamental and herbaceous plants (Chlorophytum comosum, Spathiphyllum wallisii and Mentha spicata). The chlorophyll content was considered as useful index to evaluate plant health status. It was monitored on plants set in modules that contain varied innovative growing media through a non-destructive procedure performed by an optical manual metre. On the other hand, the plant growth was assessed on the same plants by monitoring the "Total Leaf Area" (TLA) and the "Number of Leaves" that were used to calculate the "Mean Leaf Growth Index". This index was elaborated to provides indications about the mean growth of plants during the experiment running. Moreover, two-way ANOVA was performed to statistically assess the effect of these innovative substrates on chlorophyll content and TLA. Promising results were obtained for some innovative growing media such as those containing hazelnut shells, grinded cork and hemp stalks. Indeed, all three plant species set up in these growing media presented positive results concerning the chlorophyll content and the "Mean Leaf Growth Index". These outcomes suggest implementing further studies to move towards a techno-ecological strategy that consider plant physiology an essential indicator to design sustainable and efficient living walls. Moreover, this study proposes a ground-breaking methodology supported by the circular mindset that can be adopted to develop further substrates based on the upcycling of undervalued materials at local scale.

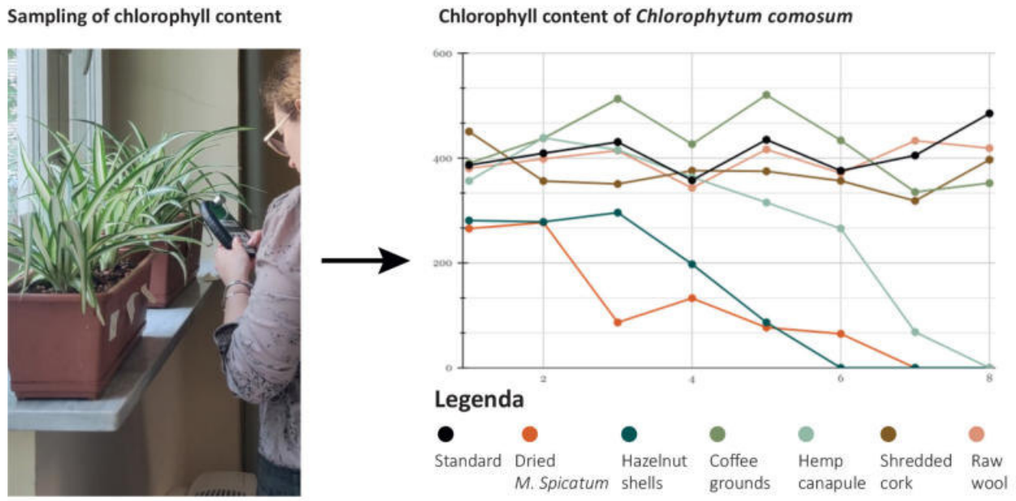

Figure 1: On the left, sampling of chlorophyll content on plants of Chlorophytum comosum. On the right, the graph of the trend of chlorophyll content of Chlorophytum comosum set up on different innovative substrates. By-products and waste upcycled to obtain growing media are reported in the legenda.