Growing Pavements: Mycelium Composites as a Sustainable Alternative to Traditional Paving Materials

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Introduction

Soil sealing, the large-scale covering of natural soil with impermeable materials, has major environmental impacts (e.g. [1] and [2]) and calls for alternative paving solutions. Fungal mycelium can act as glue between lignocellulosic particles to form a strong organic composite. This study explores the potential use of mycelium composites to resolve soil sealing related issues in four parts.

Firstly, the impacts of soil sealing are comprehensively reviewed in a literature study. Secondly, fungal physiology is explored and mycelium properties are compared to those of concrete paving. Thirdly, the relation between a fungus and its lignocellulosic substrate is studied to find an optimal substrate. Fourthly, mycelium composites are developed and compared to traditional paving materials through tests on permeability and heat retention. To conclude, possible means for short-term application of mycelium composites are identified.

Research Methods

The ability of ten unique white-rot *basidiomycete* fungi to degrade eight powdered wood sources was tested in duplicate (Fig. 1) on plates containing low-nitrogen asparagine-succinate (LN-AS) [3] agar (1.5 % agar-agar (w/v)). Complex substrates Jack Pine, Norway Spruce, Silver Birch, Willow, Ash, Beech, Aspen and Oak were added to the medium individually, to a final concentration of 3% (w/v). Two controls were prepared, one containing no carbon source and one containing 1% (w/v) glucose.

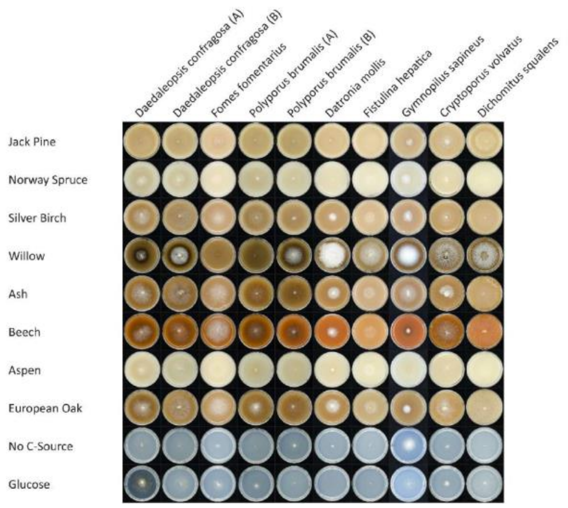

Fig. 1.: Growth profile of ten fungi on eight wood substrates and two control substrates.

Two batches of mycelium composites were developed, one using wheat straw and *P. citrinopileatus*, the other using beech wood and *P. ostreatus*. Prototypes of 15*15*4cm were created using laser cut moulds, the growth process was optimised and incubation time was set to two weeks. The created prototypes were compared to pavers through tests on heat retention, water absorption and permeability.

Results

The tested fungi showed little growth specificity towards select wood substrates. Widely varying results were found between strains, even between strains of the same species (Fig. 1). Beech wood was chosen to create mycelium composites, as it provided the most consistent growth.

Through testing, it was found that mycelium pavers retained significantly less heat compared to concrete pavers, with mycelium pavers cooling down increasingly faster as temperatures rose (Fig. 2). Approx. 15% of applied water seeped through concrete pavers, while mycelium pavers were impermeable. However, mycelium pavers absorbed far more water: 73% swell compared to 4%. Large differences were observed between the two different mycelium composites.

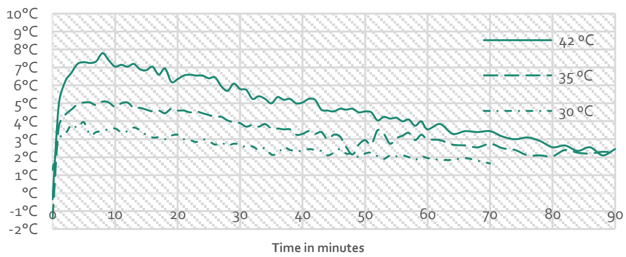

Fig. 2: Temperature difference between concrete pavers and mycelium pavers heated to approx. 42 °C, 35 °C and 30 °C.

Conclusion

Our study shows that mycelium composites can provide a sustainable alternative to traditional paving. Furthermore, it contributes to the understanding of fungal growth and how to control it. It shows that presently, mycelium paving can resolve issues related to heat-retention, concrete waste disposal and pollution. With optimisation, mycelium paving will be implementable in the near future.

References

[1] Stolte, J., Tesfai, M., *et al.* (2016). Soil threats in Europe: Status, methods, drivers and effects on ecosystem services. Brussels: European Commission.

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[3] Htakka, AI & Uusi-Rauva, AK. (1983) Degradation of 14C-labelled poplar wood lignin by selected white-rot fungi. *European Journal of Applied Microbiology and Biotechnology*. 17: 235–242.