Birch-Mediated Mycorrhizal Coupling in a Syntropic Vitiforestry System: A Pilot Study in Regenerative Vineyard Design in Switzerland

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A new experimental viticulture concept in Switzerland is being developed as a pilot project in Wohlenschwil, Canton Aargau, on a terraced vineyard plot that was previously cultivated for approximately 15 years with around 400 Maréchal Foch vines.

Following the removal of this former monoculture system, the site is being redesigned into a diversified vitiforestry succession system, integrating trees, vines, cover vegetation, and soil biology into a staged regenerative framework based on ***ecological succession and syntropic design principles.***

At the core of the system is the introduction of Betula pendula and its closely related form ***Betula pendula var. carelica***, planted not as ornamental elements or mechanical support structures in the historical Roman or medieval sense, but as active ecological engineers within the vineyard matrix. In the first phase, approximately 40 birch trees have been established across the terraces. Over time, these will be interlaced with multiple grapevine varieties, progressively evolving the site into a layered vine-forestry system with increasing structural and biological complexity.

The central hypothesis of the system is that birch acts as a functional bridge between two typically separated mycorrhizal domains, enabling a ***rare AM–EM hybrid functional landscape***.
Grapevines are primarily associated with arbuscular mycorrhizal fungi (AMF), while birch is dominated by ectomycorrhizal fungi (EMF). In most agricultural systems these networks remain distinct. In this design, birch is considered the primary driver that initiates and stabilizes an AM–EM coupling zone. Through its extensive root system, strong influence on rhizosphere biodiversity, and broad fungal associations, birch helps create overlapping soil conditions where AM and EM fungal communities coexist indirectly, increasing functional connectivity, nutrient cycling efficiency, and ecosystem resilience at the system level.

Among the selected forms, Betula pendula var. carelica is particularly relevant due to its more conservative growth pattern and lower water demand compared to typical silver birch, making it better suited for water-limited vineyard environments. This reduces direct competition with grapevines while maintaining the ecological function of the tree layer.

A key physiological mechanism is hydraulic redistribution. Deep-rooted birch trees may access water from deeper soil horizons and partially redistribute it into upper layers, potentially stabilizing vine water availability during drought periods. In parallel, birch is recognized in European ***phytoremediation*** research, including studies from Central and Eastern Europe, for its capacity to accumulate ***copper and zinc***—elements that often build up in vineyard soils due to long-term plant protection practices.

Above ground, the system provides microclimatic buffering. A ***light, deciduous canopy r***educes temperature extremes, moderates evapotranspiration, and softens heat peaks without fully suppressing grape ripening, which is increasingly relevant under conditions of climate warming and hydric stress variability in European viticulture.

Below ground, the defining innovation remains the ***birch-driven AM–EM bridging effect***. While grapevines remain AM-dependent and birch EM-dominant, their coexistence—supported by diverse cover crops acting as biological connectors—creates a ***heterogeneous and resilient soil network***. This is not a full biological fusion of mycorrhizal systems, but a functional overlap zone initiated by birch presence that enhances soil structure, microbial diversity, and ecosystem stability.

The conceptual foundation of the project is aligned with ***syntropic agriculture*** as developed by Swiss-Brazilian farmer and agroecologist Ernst Götsch. His system emphasizes ***ecological succession, stratification, continuous biomass production***, and the intentional use of natural competition as a regenerative driver.

Within this framework, birch species function as pioneer elements that actively construct ***early-stage ecosystem conditions***, accelerate soil activation, and initiate structural complexity following the vineyard's transition. Grapevines occupy more stable successional niches, while ground cover plants maintain continuous biological activity and soil protection. Disturbance through pruning, biomass cycling, and managed competition is not minimized but intentionally integrated as a regenerative mechanism.

Unlike traditional vineyard systems that rely on trees as either ornamental plantings or ***mechanical support structures in the Roman and medieval viticultural tradition***, this model establishes trees as functional components of a diversified vitiforestry succession system, where ecological roles evolve over time rather than remaining static.

To address the main concern regarding bird attraction, the birch trees will be trained to form a canopy similar to those used in intensive fruit orchards. The trees will be maintained at a ***height not exceeding 3 meters***, with the top removed early and only short lateral branches allowed to develop. This form will significantly simplify pruning and overall canopy management.

Furthermore, the ***system naturally intercalates the vine and tree branches***, allowing a more dynamic canopy structure. It also helps to reduce excessive shading in certain areas, which standard vitiforestry pruning systems often do not adequately address or permit

From an ***economic perspective***, the temporary reduction in vine density due to tree integration is considered offset by the high-value timber potential of birch biomass, particularly given that selected birch material—especially from Carelian birch—is currently traded at elevated ***prices on a per-kilogram basis*** in specialized timber markets. This introduces an a***dditional long-term revenue stream*** that complements grape production, reframing the system as a dual-output model combining viticulture and high-value woody biomass production.

By combining phytoremediation potential, microclimatic regulation, successional dynamics, AM–EM functional bridging, and diversified biomass economics, the Wohlenschwil project positions itself as a ***pioneering testbed for next-generation regenerative viticulture***, where productivity and ecosystem regeneration are treated as mutually reinforcing outcomes rather than competing objectives.

People interested in learning more about the project are warmly invited to contact the project initiators for further information or collaboration inquiries.