Wild *Vicia* species as Nature-based Solutions in poplar plantations: trade-offs between weed suppression and ecosystem functionality

Anna Corli[1,2*], Simone Orsenigo[2,3], Irene Rossi[3], Alessio Giovannelli[3,4], Pier Mario Chiarabaglio[5], Silvia Traversari[2,6], Francesca Vannucchi[2,6], Andrea Mondoni[2,3]
*lead presenter: anna.corli@unife.it

[1] Department of Environmental and Prevention Sciences, University of Ferrara, Corso Ercole I d'Este 32, 44121 Ferrara, Italy
[2] National Biodiversity Future Center, 90133 Palermo, Italy
[3] Department of Earth and Environmental Sciences, University of Pavia, Via S. Epifanio 14, 27100 Pavia, Italy
[4] Research Institute on Terrestrial Ecosystems (IRET), National Research Council (CNR) of Italy, Via Madonna del Piano 10, 50019 Sesto Fiorentino, Italy
[5] Research Centre for Forestry and Wood (CREA), str. Frassineto 35, 15033, Casale Monferrato, Italy
[6] Research Institute on Terrestrial Ecosystems (IRET), National Research Council (CNR) of Italy, Via Giuseppe Moruzzi 1, 56124 Pisa, Italy

Nature-based Solutions (NbS) are increasingly used to design multifunctional agroecosystems, yet empirical evidence from perennial tree-based systems remains limited. In this context, the use of native species as cover crops has gained attention for its potential to enhance plant diversity and functional recovery but remains underrepresented in both research and practice.

Here we evaluated the potential of wild *Vicia* species as NbS-oriented cover crops in poplar plantations by comparing a single-species (*V. villosa*) with a multi-species mixture (*V. villosa*, *V. pannonica*, *V. sativa*). Two mesocosm experiments were conducted: a) a transplant experiment using juvenile plants to assess reproductive traits, phenological dynamics and self-regeneration, and b) a direct-sowing experiment to evaluate seedling emergence and weed suppression under realistic establishment conditions. Short-term soil responses were also evaluated.

V. villosa exhibited higher reproductive output when planted alone, whereas multi-species mixtures displayed marked phenological complementarity, with species-specific flowering times that extended the overall flowering period. Yet, self-regeneration was limited. Seedling emergence was moderate (37%), rapid and species-dependent, with *V. pannonica* showing the highest percentage (66%). Single-species treatment (*V. villosa*) significantly reduced weed biomass compared to control plots, while mixtures showed more variable suppression. Despite this, proportional weed biomass did not differ between single and mixture. No significant short-term effects on soil chemical or biochemical properties were detected over a single growing season.

Overall, our results reveal clear trade-offs between single-species and multi-species mixtures, with the former optimizing specific functions such as weed suppression, and the latter supporting ecosystem functionality through phenological complementarity and functional diversity. Wild *Vicia* species represent promising NbS as cover crops for poplar plantations, contributing to weed suppression, flowering support and increased plant diversity within simplified production systems.