

## Supplementary information

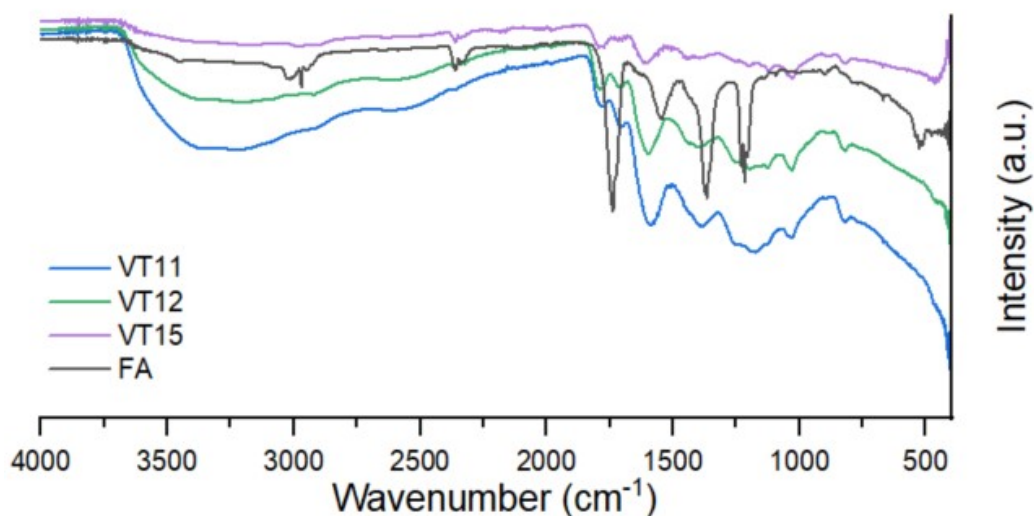


Figure S1. FTIR spectra comparison of initial aquatic FA and modified FA with phenolic precursors (runs: VT11, VT12, and VT15).

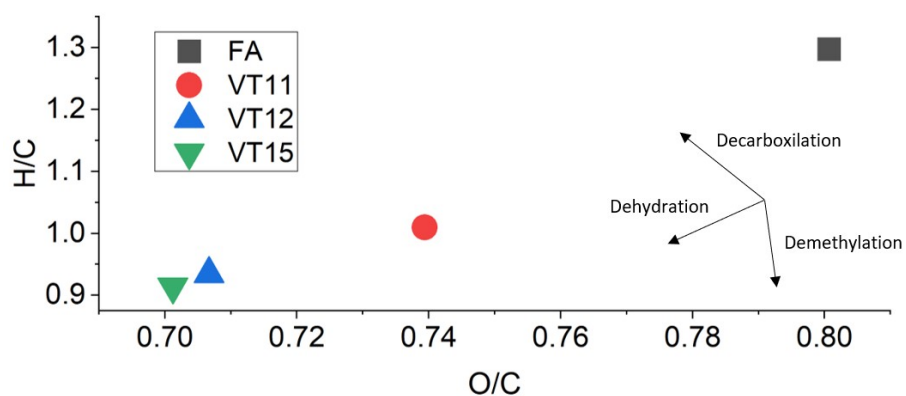


Figure S2. The Van Krevelen diagram provides a graphical representation of the elemental composition and structural characteristics of the initial aquatic FA and the modified FA samples obtained through different runs: VT11, VT12, and VT15. This diagram offers insights into the relative abundances of carbon (C), hydrogen (H), and oxygen (O) present in the samples, allowing

for a comprehensive assessment of the compositional changes induced by the addition of phenolic precursors.

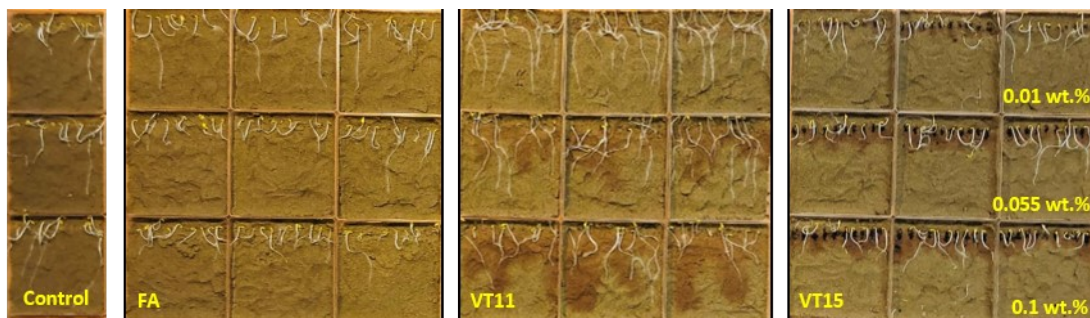


Figure S3. Unmodified FA, VT11 and VT15 visual distribution in the soil upon tenfold increased concentration.

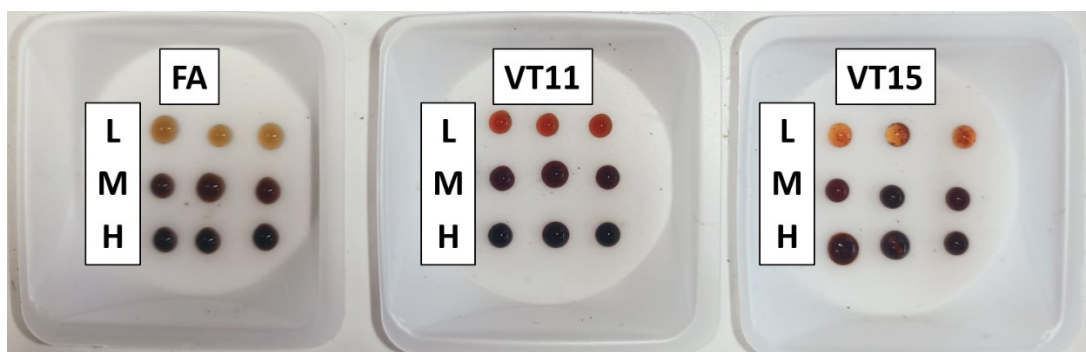


Figure S4. Solutions of both the modified variants (VT11 and VT15) and the initial unmodified FA deposited onto the white tray. The deposition of the solutions on the white tray allowed us to visually examine and assess any observable differences, such as changes in color, consistency, or solubility, which provided valuable information about the modifications made to the FA.

