Tomato stem-reinforced composites: Biobased and biodegradable materials for a virtuous circular approach in the horticulture sector

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Tomato stems are the post-harvest biomass remaining from greenhouses after the period of tomato production. European production of tomato is rather stable (approximately 17 M tons in 2023) and stems and leaves represent approximately 1/5 of the usable production. The current method of growing tomatoes in greenhouses consumes many plastic accessories that are almost exclusively produced from petro-sourced and nondegradable polymers. The clips that fix the stem on the string and the bouquet holders that reinforce the peduncle represent about 500,000 pieces/ha and prevent the composting of plant by-product after greenhouses are emptied.

To develop a virtuous circular bioeconomy approach, tomato biomass was first evaluated as reinforcements for designing a range of degradable and biobased thermoplastic composite materials. The mechanical characterization shows that the tomato stem-reinforced materials can compete with existing formulations [1].

In a second step, the biodegradability of the tomato stem-reinforced materials was assessed using biochemical and imaging approaches along the enzymatic degradation by a mixture of cellulases and pectinases. Isolated or embedded in various matrix polymers, tomato stem particles remained sensitive to enzymatic degradation. Tomography analysis showed that the degraded samples exhibited a large increase in porosity, and that the biodegradation efficiency depends on the polymer tested [2].

This fully circular approach from waste to useful compounds for horticulture and market gardening is a promising way of upcycling tomato biomass, compatible with end-of-life composting.

[1] A. Bourmaud, K. Konschack, C. Buffet, M. Calatraba, A.L. Rudolph, A. Kervoëlen, B. Gautherot, E. Bonnin, J. Beaugrand, "A circular approach for the valorization of tomato by-product in biodegradable injected materials for horticulture sector" Polymers, 15, 820, 2023. doi.org/10.3390/polym15040820

[2] E. Bonnin, M. Calatraba, X. Gabrion, C. Alvarado, C. Buffet, A. Day, L. Brionne, A. Bourmaud, J. Beaugrand, "Biodegradability of tomato stem-reinforced composites: Towards a virtuous approach to local and circular waste upcycling", submitted for publication