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Turning Food Waste and Agrifood Residues into Animal Feed Ingredients and Organic Fertilizer Using Insects – a Greek Pilot

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Abstract

Our food system is dysfunctional: While 10% of human population is undernourished, we feed food-grade materials to livestock and waste 1 billion tons of food every year. Insects can help us break this resource-intensive pattern: Larvae of black soldier fly (BSF) *Hermetia illucens* can be mass-reared on food waste and agrifood byproducts to be processed into nutritious, safe animal feed ingredients, while leftover frass is an efficient organic fertilizer with plant-beneficial effects. Indeed, “BSF farming” can significantly contribute to the sustainability and resiliency of the global food system, if it is taken up at a wide scale. In this sense, small/ medium rural applications are at least as important as industrial ones. In Europe, the mild climate and unvalorized agrifood residues of the Mediterranean region can allow BSF-farming with minimal active climate control and feedstock-costs. To demonstrate this potential, we took rural Greece as a case. We conducted BSF larval growth experiments from July 2024 to December 2025 in an experimental greenhouse in southern Greece, with minimal climatization, mimicking commercial horticulture greenhouses of the region. Larval growth and bioconversion performance as well as the effects of rearing parameters on these were in line with findings under more tightly controlled conditions. The unstable ambient temperature enabled us to pinpoint the boundary conditions for bioconversion under variable temperature regimes, which, to our knowledge has not been previously studied. Based on this, we estimated the energy demand for maintaining permissive variable temperature regimes for year-round BSF farming in a Mediterranean greenhouse, in comparison to the respective energy demands in other settings with constant temperatures. In the same greenhouse setting, we incorporated local agrifood residues as feedstock, focusing on un-/ under-valorized materials. Particular combinations of olive mill residue, cheese whey, raw dough, bakery rejects, greenhouse crop residues and brewer’s spent grain were efficiently bioconverted. We present an outlook on how these partially seasonal materials can be stored and pre-processed with minimal energy use to be integrated into year-round operation at a meaningful scale. Overall, these results concerning climatization and feedstock highlight rural Greece in particular, and the Mediterranean region in general as a promising context for cost-effective, sustainable BSF farming.

Keywords: food waste, agrifood byproducts, alternative proteins, animal feed, organic fertilizer, Medittерenean

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