A Passive Biological Approach to Remove Plant Pathogens from an Organic Greenhouse Effluent.

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Background:
Due to the lack of high quality water and potential pollution of groundwater by leached nutrients, recirculation or treatment of agricultural wastewater is now unavoidable. Even though recycling growing systems offer several advantages from an environmental point of view, risks associated with pathogen spread, unbalanced nutrient solutions and build-up of phytotoxic compounds are major concerns for growers. Moreover, conventional approaches to treat effluents coming from organic crops are often not efficient due to their high content in organic matter.

Project Overview:
Therefore, the objective of this study was to evaluate the effectiveness of three types of artificial wetland to reduce the population of *Fusarium oxysporum* and of *Pythium ultimum* in greenhouse effluents. To do so, an experiment was conducted under greenhouse conditions using horizontal subsurface flow artificial wetlands (HSSF-AW) filled with pozzolana and implanted with common cattail (*Typha latifolia*). Wetland units contained either 1- sucrose (AWS), 2- compost (AWC) or 3- no external (AW) carbon source. The experimental design was a complete randomized block design with four replicates (total of 12 e.u. of 0.08 m^3) and a retention time of 5 days. Wetland units received a reconstituted greenhouse effluent and, were weekly inoculated with a suspension of *Fusarium oxysporum* (10^6 CFU per mL) or of *Pythium ultimum* (10^6 CFU per mL). Daily samples of AW-effluent were collected and *F. oxysporum* and *P. ultimum* concentration was evaluated using the selective Komoda and PDA-PARP media, respectively. Total organic carbon, biofilm, cell wall degrading enzyme (CWDE) and populations of mesophilic bacteria, *Pseudomonas* spp., and *Bacillus* spp. were evaluated. Results showed that each type of HSSF-AW was efficient to reduce by 99.9% measured population at the effluent level. Physical, chemical and biological removal mechanisms as well as environmental conditions were evaluated to explain this observed high removal percentage. The compost amendment (AWC) promoted the biofilm development around the filter media and wall degrading enzymes (CWDE), which played a role for plant pathogen removal. The relative importance of the different processes (biofilm adsorption, CDWE, antagonistic properties) is hardly definable, mainly due to the fact that the effective processes may interact. However, processes involved varied according to the AW carbon content. Compost amendment (AWC) allowed a better biofilm formation and CDWE production, while microflora with antagonistic properties (*Bacillus* spp. and *Pseudomonas* spp.) was more numerous when sucrose (AWS) was provided. Nevertheless, AWs without any exogenous source of carbon were as effective to eliminate studied plant pathogens as enriched carbon artificial wetlands.

Conclusions: This study showed for the first time that HSSF-AW may constitute a sustainable alternative method to remove plant pathogens from the greenhouse effluent with a removal efficiency of 99.99%, which is an acceptable threshold for the industry.

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