Digestate biofertilizers support similar or higher tomato yields and quality than mineral fertilizer in a subsurface drip fertigation system

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Abstract

This study investigated the effects of applying anaerobically digested food waste and dairy manure-derived biofertilizers to processing tomatoes. The biofertilizers were produced from a pilot scale system consisting of coarse solid separation and ultrafiltration (5,000 Da) with a capacity of approximately 3.8 $m^3 \cdot d^{-1}$. The coarse solids had particle size greater than 53 µm and were not used for drip fertigation. The liquid concentrate and permeate from the system were both delivered to tomato plants through a subsurface drip fertigation system in a farm-scale cultivation experiment. The results showed that liquid digestate biofertilizers could be effectively delivered to the tomato plants given that steps to ensure suitable particle sizes were maintained prior to delivery. The ultrafiltered dairy manure digestate biofertilizer (DMP) had the highest yield of red tomatoes (7.13 tonne$\cdot ha^{-1}$) followed by the concentrated food waste digestate biofertilizer (FWC) and mineral N fertilizer treatments with 6.26 and 5.98 tonne$\cdot ha^{-1}$, respectively. The FWC biofertilizer produced tomatoes with significantly higher total and soluble solids contents compared to the synthetically fertilized tomatoes. Few significant differences between the treatments were observed among the pH, color, or size of the red tomatoes. These results indicate promise for the prospect of applying digestate biofertilizer products to tomatoes using the industry standard subsurface drip fertigation method. Additionally, digestate-derived biofertilizers may have potential to increase crop yields as well as certain quality characteristics of the harvested tomato fruit. No changes in soil quality were found among treatments but more study is required to understand long-term effects of biofertilizer applications with regards to soil quality and environmental risks.

Keywords: Anaerobic digestate, tomatoes, liquid fertilizers, biofertilizer, subsurface drip fertigation, ultrafiltration