ABSTRACT

Rotary Drum Compost and Compost Tea as Substrates, Amendments, and Biocontrol Agents for Damping-off (*Pythium ultimum*) Management in Tomato (*Solanum lycopersicum*)

Chaney Cuthbert Grayham St. Martin

The use of costly imported peat (*Sphagnum* spp.)-based substrates, which are conducive to damping-off, limits the profitability of commercial vegetable enterprises in the Caribbean. Damping-off, a non-host-specific soil-borne disease, can result in significant vegetable seedling loss and yield reductions. The primary goal of this dissertation research was to assess high-rate rotary drum technology as a means of producing mature banana leaves (*Musa acuminata* Colla) and lawn clippings [*Axonopus compressus* (Swartz) Beauv.] composts of consistent quality, for use as soil-less growth substrates, which are suppressive to damping-off (*Pythium ultimum*) in tomato (*Solanum lycopersicum*). The use of compost tea as a nutrient amendment and biocontrol agent against damping-off of tomato cultivated in compost-amended peat-based substrate, which is inoculated with the endomycorrhizal fungi *Glomus intraradices*, were also investigated.

Stable composts, which were produced within 19 d using rotary barrel composters, had significantly higher *P. ultimum* suppression efficacy than the commercial fungicide UltraFlourish® (Nufarm Americas Inc., Illinois, USA), consistent quality across production batches, and were suitable for use as components of plant growth substrates. Across compost types, bacterial population was positively related to growth inhibition of *P. ultimum* whereas total microbial population had a positive relationship with growth inhibition in lawn clippings compost. Composts were, however, phytotoxic and suitable as substrate components at an inclusion rate of 20% (v/v) with peat-based substrate inoculated with *G. intraradices*.

In contrast, compost teas stimulated *in vitro* seed germination of tomato and compost type significantly affected the suppressive efficacy of compost teas. Significantly higher growth inhibition levels were achieved with lawn clippings compost teas (86%) compared to banana leaves compost teas (36%). However, aerating compost tea did not consistently result in higher growth inhibition levels across compost types. Neither did increasing brewing time

beyond 18 h for aerated compost teas and 56 h for non-aerated compost teas. Yeast populations of aerated compost teas were positively related to growth inhibition whereas bacterial populations had a positive relationship with growth inhibition for non-aerated compost teas.

Damping-off was suppressed 100% when aerated compost tea made from lawn clippings compost and brewed for 36 h, was applied to non-autoclaved peat-based substrate inoculated with *G. intraradices*. In contrast, non-aerated compost tea made from lawn clippings compost and brewed for 168 h, suppressed the biocontrol capacity of non-autoclaved peat-based substrate inoculated with *G. intraradices* and severe damping-off was observed in all autoclaved substrates.

With the exception of leaf area, unfiltered compost tea + fertiliser supplied to non-autoclaved peat-based substrates inoculated with *G. intraradices*, had no significant effect on growth parameters measured. In contrast, within non-autoclaved peat-based substrate not inoculated with *G. intraradices*, unfiltered compost tea + fertiliser resulted in significantly higher tomato seedling growth than the fertiliser only treatment. *G. intraradices* did not colonise tomato roots and network width to depth ratio was the most important root system architecture trait affecting shoot growth. Network length distribution was more related to nutrient uptake than root traits associated with substrate exploration, and both positive and negative microbial priming effects were observed in nutrient amendment studies.

Research findings show that the compost teas produced, may be of greater practical relevance to farmers as amendments and biocontrol agents against damping-off than compost.

Keywords: *Glomus intraradices*; banana leaves; lawn clippings; root system architecture; nutrient uptake; phytotoxicity; seedling growth; damping-off; soil-less.