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The Influence of Aeration System, Temperature and Compost Origin on the Phytotoxicity of Compost Tea

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Numerous studies have evaluated compost teas' capacity to suppress plant disease, but no study has been made of possible compost tea phytotoxicity. In this study, 24 assays were carried out on compost tea produced from three different composts: one produced from bovine manure (M) and two others made from municipal solid waste but differing in the degree of stability (stable: MSW I and unstable: MSW II); using two aeration systems: continuous and discontinuous aeration, and at three temperatures: 10, 20 and 30°C. The aim was to evaluate the influence of production conditions on the phytotoxicity of tea. In addition, the evolution of phytotoxicity over the period of extraction was also studied, as well as the influence that dilution of the tea before its application has on phytotoxicity. Phytotoxicity was evaluated by means of Zucconi's germination test using lettuce seeds and in addition a growth test was carried out using two teas: M-N-10i and MSW I-A-20, using two types of seeds: barley and lettuce. Compost teas were chemically analysed for pH, EC, NH_4^+-N and heavy metals in order to explain differences in phytotoxicity. According to Zucconi's test, all the teas, independently of the dilution rate, caused negative effects on root length of lettuce seeds. However, growth tests showed more positive results, with growth inhibited only at very high tea concentrations. A growth test is likely to be more reliable than a germination test because application conditions are closer to real conditions. Aeration and temperature influenced compost tea phytotoxicity, with aerated teas produced at low temperatures causing less phytotoxicity. Furthermore, tea phytotoxicity was also dependent on the stability of the compost from which the tea was produced; unstable compost produced compost teas of greater phytotoxicity.

Introduction

Compost teas are liquid extracts of compost obtained by mixing compost and water for a defined period of time (Ingham 2002). Compost teas contain nutrients and diverse organisms and are applied to the soil or directly to plants with a double aim. On the one hand compost tea application is known to provide nutrients and organic matter to the soil. On the other hand, an increasing body of experimental evidence indicates that compost tea can suppress some plant diseases, such as botrytis on green beans, strawberries, grapes and geraniums, powdery mildew on apples, etc. (Al-Dahmani *et al.* 2003; Scheuerell & Mahaffee 2004; Diánez *et al.* 2006).

The recent increase in sustainable and organic farming and problems relating to pesticide use has stimulated the development of a wide variety of commercially available devices and products for on-farm production of watery extracts of compost (Ingram & Miller 2007), and this has led to a slow increase in scientific papers and nonrefereed publications relating to compost teas (Litterick *et al.* 2004).

There is strong evidence that compost tea application is producing measurable benefits (Scheuerell & Mahaffee 2002). Nevertheless, these effects depend on the quality of the compost used to produce the tea. Poor quality compost teas could have negative effects on plants, including a decrease in yields and the inhibition of seed germination and plant growth. Phytotoxicity is described as an intoxication of living plants by substances present in the growth medium, when these substances are taken up and accumulated in plant tissue (Chang *et al.* 1992), and is one of the most important criteria for evaluating the suitability of compost for agricultural purposes (Tang *et al.* 2006; Cooperband *et al.* 2003). The phytotoxic effects produced by organic waste application are the result of a combination of several factors rather than one (Iglesias & Pérez 1989; Hoekstra *et al.* 2002). These factors potentially include the presence of heavy metals (Wollan *et al.* 1978; Wong *et al.* 2001), ammonia (Wong *et al.* 1983), an excessive accumulation of salts (Tam & Tiquia 1994; Adriano *et al.* 1973) and low molecular weight organic acids (Zucconi *et al.* 1985), all of which have been shown to