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The process of production compost tea and its usage in agriculture: a review

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ABSTRACT: By mixing compost with water and culturing for a limited period.The use of Compost teas have useful effects on plants. High quality compost refers to compost that is high in microbiological activity. Compost tea is made by two brewing methods: non-aerated method and aerated method. For both methods, microbial food may or may not be added in compost tea production. The inconsistency has been associated with a number of factors that affect the production process. Compost contains a diverse group of organisms dominated by bacteria and fungi participating in decomposing of organic matter. Compost teas decrease plant Disease when used as soil drenches or foliar sprays. Compost tea as potential alternatives are viewed to use of synthetic chemical fungicides. Dilution of the tea prior to foliar application may reduce the nutrients and microbial population. Compost is comprised of a large and diverse community of microbes, human acids and other chemical nutrients such as carbon and nitrogen that soil and healthy plant growth.

***Keywords*:** compost tea, organisms, organic matter , non-aerated method, aerated method

INTRODUCTION

By mixing compost with water and culturing for a limited period, we can produce compost tea, either aerated compost tea, or not. Non- aerated-compost-tea and with or without activities that increase microbial population densities during production (NOSB, 2004; Scheurell and Mahaffee, 2004). Additional nutrients and adjuvants may be added .The application system determines the need for filtering compost. Tea before application (Scheurell and Steven, 2002).

Compost tea is a liquid made from leaching. Nutrients and extracting bacteria, fungi, nematodes and protozoa .From finished compost .compost is put in a mesh or nylon bag- and steeped in water for a period of time, while being aerated .By an air pump usually a type of sugar as microorganisms. From compost is added (Diver, 2002).

Compost teas are used for their Beneficial effect on plants (Litterick , 2004). Compost teas decrease plant Disease when used as soil drenches or foliar sprays (Scheuerell and Mahaffee, 2004; Scheuerell and Mahaffee, 2002). Compost tea as potential alternatives are viewed to use of synthetic chemical fungicides (Siddiqui , 2002). There are disease suppressive effects in numerous agricultural system, their efficacy remain variable (Scheuerell and Mahaffee, 2006).

A solution created by extracting microorganisms and nutrients from compost is compost tea. Specific types of compost create an optimal balance of fungal organism, these organisms occur in the soil. The organisms in a healthy soil food web function to:

- ✓ Protect roots and other plant from pathogens and disa.
- ✓ Provide nutrients to plants.
- ✓ Improve overall health of plants (Dimas , 2009).

Compost and compost tea

High quality compost refers to compost that is high in microbiological activity (Dimas , 2009). Compost maturity is another import characteristics to compost tea quality. Mature composts release levels of soluble mineral nutrients and fewer pay to toxic organic acids and heavy metals than immature materials (Griffin and Hutchinson, 2007).

Compost tea is made by two brewing methods:

- Non- aerated method
- Aerated method

Non-aerated compost tea (NCT): NCT relies on the use of stable compost without sugar additives, under low oxygen with occasional stirring of the extract. Average NCT brewing period is 14 days. In NCT there is no organism with oxygen (Scheuerell, 2003). Anaerobic conditions during tea production, limits growth of microorganisms (Kelley, 2004). Non aerated compost tea prepare during 2 weeks. Aerated compost tea (ACT): producing Aerated compost tea in a shorter brewing time ranging from 12 hrs to 3 days. In the aerated method produce aerated compost tea the mixture is deliberately aerated (Ingham, 2005; Scheuerell, 2003; Kelley, 2004). For both methods of compost tea production microbial food may or may not be added. If additional food is not added .organisms are not active and less to survive the transfer from mixture to soil or applications to plants surface (Ingham, 2005). ACT can be prepared in 2 to 3 days (Kelley, 2004). ATC production creates fewerodours and reduce the risk of contamination by human pathogens.

Compost tea quality production process

Some parameters, such as ratio of compost to water, oxygenation levels, duration and temperature of fermentation effect compost tea production. The amendment of aqueous extractant with fermentation nutrients, such as food industry waste was proposed (Pane , 2012).

The brewing or fermentation process refers to the process of steeping compost in water at a constant temperature and for a defined period of time. Microorganism convert insoluble nutrients in to available nutrients during the brewing process (Scheuerell and Mahaffee, 2006). The inconsistency has been associate with a number of factors that affect the production process (Ingram and Millner, 2007; Scheuerell and Mahaffee, 2006; Ingham, 2005; Hsiang and Tian, 2007)**.**

These factors include:

- Compost grade
- Compost to water ration
- Brewing time
- Fermentation nutrients
- Microbial supplement
- Aeration
- Filtration and dilution before application.

Compost grade

The organic ingredients or feed stocks include animal manure landscape and agricultural plant material, bio solids and food waste the make up the mature compost. Each has characteristics that influence the quality of the mature compost (Scheuerell, 2002). Vermin compost is used as an ingredient in many compost tea recipes. This compost is the highest in available nutrients (Brinton , 2004). mature compost should be stable and free of pathogens. The immature compost is less stable and may harbor pathogens (Noble , 2004).

Compost to water ratio

Ratio of compost to water tend to vary for each production method. For NCT, the majority of studies use a 1:3 – 1:10 ratios (Scheuerell and Mahaffee, 2002). For act, ratio depends on type of equipment .Chloramines are added to potable water as a sanitizing agent.

Brewing time

Not brewing time of 8-16 days is optimal fermentation time for any level of disease control (Scheuerell, 2002). Longer brewing period promotes greater amount of nutrients to be extracted from the compost and enables

accumulation of antibiotics that activate natural plant defense responses and help in disease suppression (Scheuerell, 2003). Optimal brew time of 18-24 hours concedes with maximum activity of microbial population in the tea (Ingham, 2005).

Nutrient supplement

Nutrients such as kelp, fish hydro lysate, molasses humic acid are added as catalysts or microbial starter (Naidu. , 2010; Scheuerell, 2002). During brewing process to promote selective enrichment of microorganism .For both ACT and NCT, fermentation nutrients have the ability to inhibit or increase growth rates for different types of organisms (Scheuerell and Mahaffee, 2004). Nutrients should be added with extreme caution (Scheuerell and Mahaffee, 2004; Ingham, 2005).

Microbial supplement

Compost contains a diverse group of organisms dominated by bacteria and fungi participating in decomposition of organic matter (Brinton and Droffner, 1995; William and Brinton, 2000). Bacteria can grow and multiply in both oxygen rich aerobic and low or no oxygen anaerobic environments (Droffner and Evans, 1995). subsets of these species known as facultative anaerobes there in low oxygen environment but are able to grow under aerobic conditions .presence of facultative anaerobes in mature compost is likely associated with disease suppressive traits. Various fungal root rot disease have been suppressed by incorporating compost in to soil or soil- less growing media (Hoitink and Hadar, 1993).

ACT aerobic bacteria predominate (Weltzien, 1991), while NCT the population of batten is mainly facultative anaerobes (Weltzien, 1991).

Aeration

Aeration or oxygenation during ACT brewing process encourages growth and propagation of diverse group of good microbes extracted from the compost (Ingham, 2005), while limited or lack of oxygen during NCT brewing process may support growth of human and plant pathogens (Scheuerell and Mahaffee, 2002; Ingham, 2005; Brinton and Hill, 2004). Brewing conditions in non –aerated compost tea .that favor a brief period of low oxygen may increase diversity of active microorganisms and disease suppressive properties of NCT (Scheuerell and Mahaffee,. 2004), while sterilization of NCT eliminates the microbial population and disease suppression in the laboratory studies (Scheuerell, 2002).

NCT and ACT brewing techniques were compared with or without aeration and in presence or absence of nutrient additive for suppression of fungus phythium damping off of cucumber seeding. There is no significant correlation between the microbial population in the compost tea brewed under continuo aeration and disease suppression (Scheuerell , 2006).

Aeration during compost tea production process produces fewer foul odors than the non-aerated production process .For NCT, foul orders has been reported only under conditions where nutrient additives were added during the fermentation process (Scheuerell and Mahaffee, 2002; Scheuerell , 2006).

Application process

Filtration and dilution are often necessary when the tea is applied through irrigation system or sprayers to avoid clogging the nozzle. For both NCT and ACT, filtration may remove suspended particles in the compost tea that contain benefic microbes (Scheuerell, 2002). Dilution of the tea prior to foliar application may reduce the nutrients and microbial population.

For soil application use a volume sufficient to reach the root area (Scheuerell, 2002; Ingham, 2005; Brinton and Droffner, 1995). Soil application to protect the roots from potential colonization of root pathogen and promote healthier plants .Maximum coverage of leaf surface area may necessary for the beneficial microbes in the tea to outcompete colonization by plant pathogens ,frequent and repeated applications are needed to maintain the surface coverage (Ingham, 2005).

Benefits of compost tea

The main performance objectives for which compost teas being used in agriculture (Scheuerell SJ, 2003; Kelley S. 2004; Grobe K. 2003a):

- Developing disease suppression or resistance towards disease to promote crop health and to reduce the need for pesticides.

- Provision of water soluble available, nutrients for plants to decrease fertilizer requirements and associated costs.
- Increased soil microorganism population and diversity to improve soil structure, water retention, rooting depth and plant growth.
- Populating leaf surface thereby restricting growth of pathogens.
- Competing for nutrients required by pathogens.
- Secreting secondary metabolites on plant surfaces.
- Directly parasitizing pathogens stimulating plant natural defence system.

Plant disease suppression

Biological interactions that result in disease suppression of plant and soil borne pathogens are complex because disease caused by pathogens occur in a dynamic environment .These interactions are occur through the following mechanisms, which are not mutually exclusive.

- Antibiosis: some beneficial organism can produce antibiotics or other substances that are toxic to the pathogenic organisms bacteria pseudomonas florescent strain CHAO produces hydrogen cyanide 2,4-diacetylphloroglucinol and pyoluteorin ,which directly interfere with growth of various pathogens (Handelsman and Stabb, 1996; Weltzien, 1991; Haas and Défago, 2005).
- Competition –when beneficial microorganisms are present in a growth medium they tend to outcompete pathogenic or fungi for food source (Hoitink and Hadar, 1993).
- Induced resistance: some beneficial microbes colonizing on plant roots or foliage are documented to confer resistance to plant by turning on genes that increase plant tolerance to infection by pathogens (Haas and Défago, 2005).
- Parasitism: certain beneficial microbes can feed on specific pathogens. trichoderma species are shown in various studies to secrete enzymes that digest the cell wall of some fungal root pathogens (Handelsman and Stabb, 1996).

Improve soil structure and plant vitality

Compost is comprised of a large and diverse community of microbes, human acids and other chemical nutrients such as carbon and nitrogen that soil and healthy plant growth .Primary interest in application of compost tea versus compost is due to the fact that composts act more slowly over a long period of time and much larger amount is required. Effects of compost tea are short lived and frequent and repeat applications are required to replenish plant or soil surface with nutrient and/or beneficial microbes (Scheuerell, 2002; Ingham, 2005; Brinton and Droffner, 1995).

Potential Problems Associated With Compost Tea Contamination with Human Pathogens

Conflicting reports of compost tea preparations containing *E. coli,* and public concern about risk of contamination of food crops prompted the United State Department of Agriculture National Organic Standard Program (NOSP) to establish a Compost Tea Task Force in 2002. The task force reviewed available science and testimonial from growers and producers and published a final set of standards in 2004 that can be applied for the use of compost tea in organic farming.

Contamination with Plant Pathogens Factors Associated with Human Pathogens

The following are factors associated with human pathogens that the Task Force considered while developing recommendations.

• ***Actual pathogens present.***

The presence or growth potential of many pathogens has not been thoroughly evaluated for different compost teas.

• ***Contamination level of compost teas****.*

Available research has used non-stable compost with readily detectable populations of human pathogens or compost artificially inoculated with human pathogens. For artificially inoculated compost, research has demonstrated a high degree of variability in final pathogen populations across replications of the same compost tea production treatment (Scheuerell and Millner, personal communication). Data currently relate to pathogens suspended in the tea, rather than the number that survive on the surface of edible fresh produce after tea is directly applied to plant surfaces.

• ***Pathogen survival***

In the environment pathogen populations typically decline over time, unless deposited in a site with all conditions conducive for survival or growth. For example, Liao (2003) demonstrated that human pathogens present in dairy manure were not detectable 70 days after application to potato production fields. In a review of published data on the survival of human pathogens on plant surfaces, Epstein (1997) indicated that most studies found bacterial pathogens to survive for <1 day to a maximum of 35 days on plants, and the longest cited survival time of any pathogen was 68 days.

• ***Crop architecture and exudate profile***

Potential for the crop to enable pathogen survival or growth. Lettuce and apples are the best known examples for harboring bacterial pathogens in sites protected from environmental stress and likely releasing sufficient nutrients to support pathogen metabolic activity.

• ***Environment***

Particularly important for above ground portions of plants. Ultraviolet radiation and dessication are the two most important environmental factors causing pathogen destruction (National Organic Standards Board, 2004).

Is tea better than solid compost?

"This does not mean that there is not merit to using straight compost in a soil amendment situation. But mechanically, you can't take that and put it on foliage. So years ago, people began figuring out ways to extract it into water so they can spray it."Dr. Elaine Ingham, author of *The Compost Tea Brewing Manual*, and principal of Soil Food web, Inc., in Corvallis, OR, lists several positive factors for aerobic teas properly brewed from good compost or worm castings:

*Improved plant growth
*Reduced application rates of chemical pesticides, herbicides and fertilizers
*Reduced impacts of chemical-based pesticides, herbicides and fertilizers on beneficial microorganisms in the ecosystem
*Occupation of infection sites on the plant surface so pathogens cannot infect the leaf
*Improved uptake of plant nutrients
*Increased numbers of organisms on and around plants to compete with disease-causing organisms, reducing disease incidence
*Retention of microorganisms in soil or on leaf surfaces, resulting in an increase in retention of nutriaents
*Increased plant nutritional quality
*Production costs are reduced
*Reduced application of toxic chemicals, thus reducing run-off into lakes and streams
*Reduced toxic impacts on humans and pets.

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