The Sustainable Materials Management Webinar Series

"Compost Tea – Something Good is Brewing"

Tuesday September 16, 2013/1:30 – 2:45PM EDT

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Maine Department of Environmental Protection

Pennsylvania Recycling Markets Center

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Compost Tea and Disease Suppression

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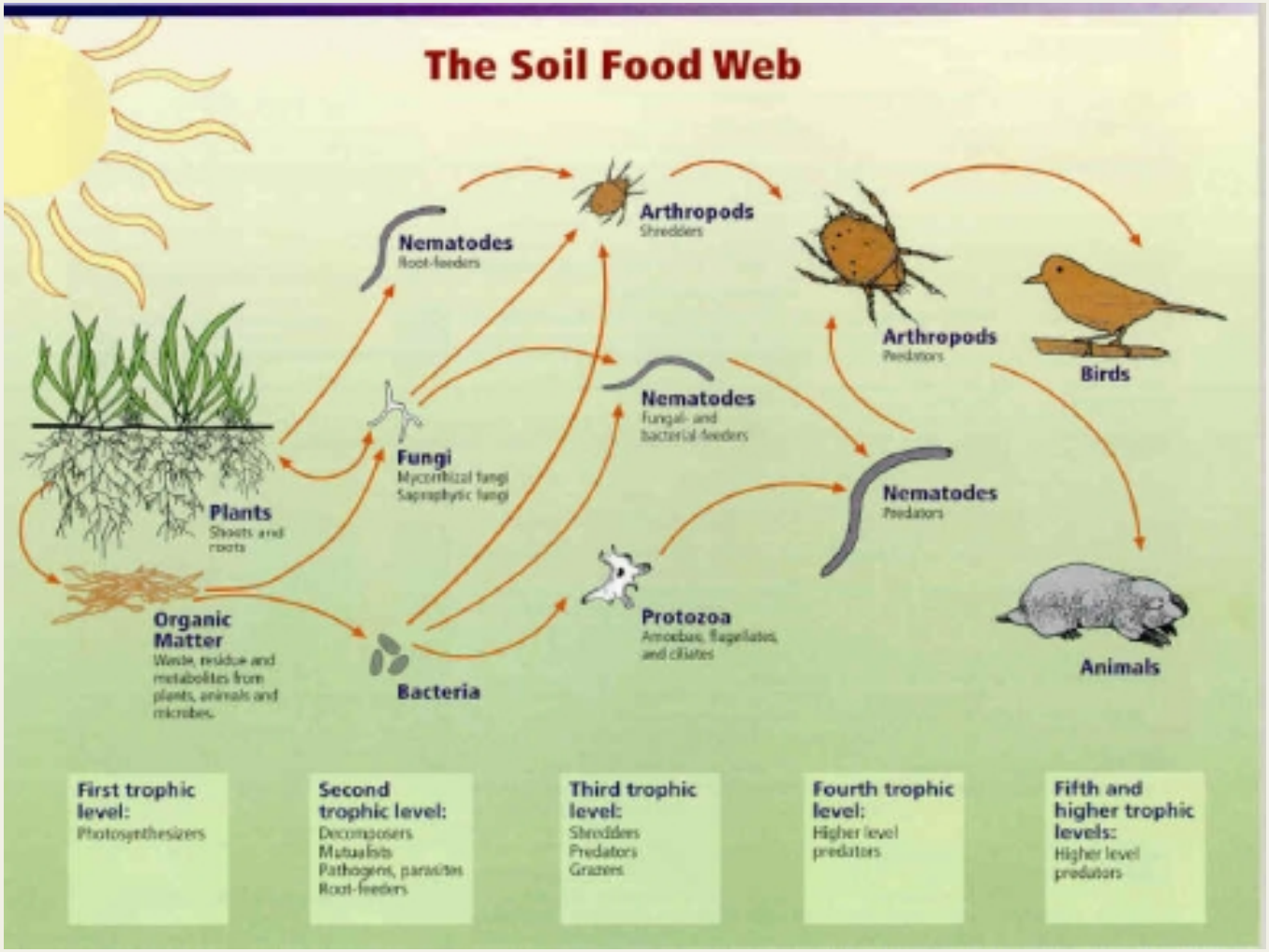
Healthy Soils Possess…..

- Adequate Micronutrients
- Strong CEC
- Adequate Moisture Holding Capacity
- Excellent “Cohesion”
- Complex “Soil-life”



A functioning food web is Essential to Soil Productivity

From: *Soil Biology Primer*

SOIL BOURNE PATHOGENS

- PYTHIUM--[Root Rot]
- RHIZOCTONIA--[“Black Scurf”--potatoes]
- FUSARIUM--[Wilt]
- PHYTHOPTHERA--[Potato Blight]

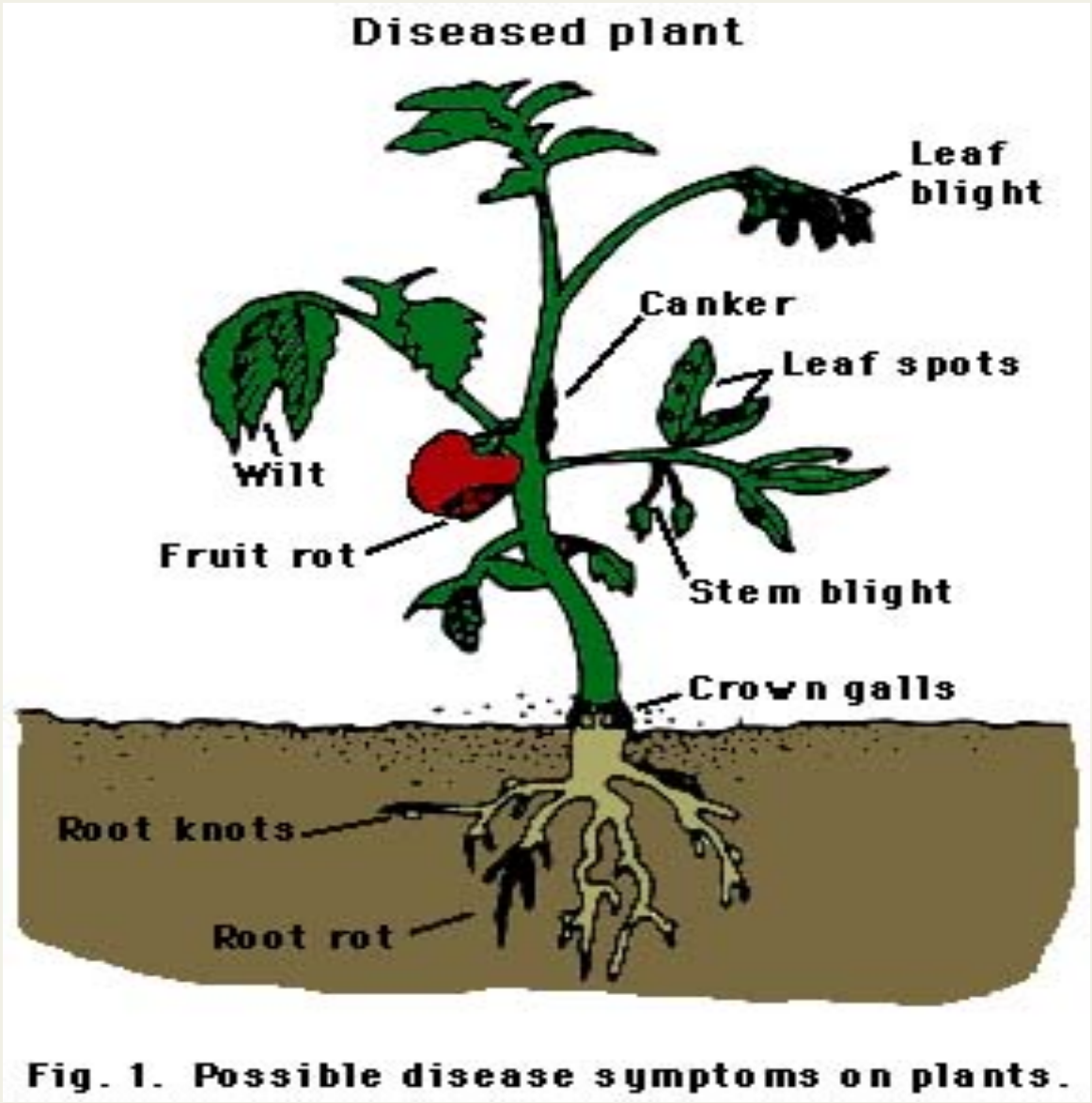
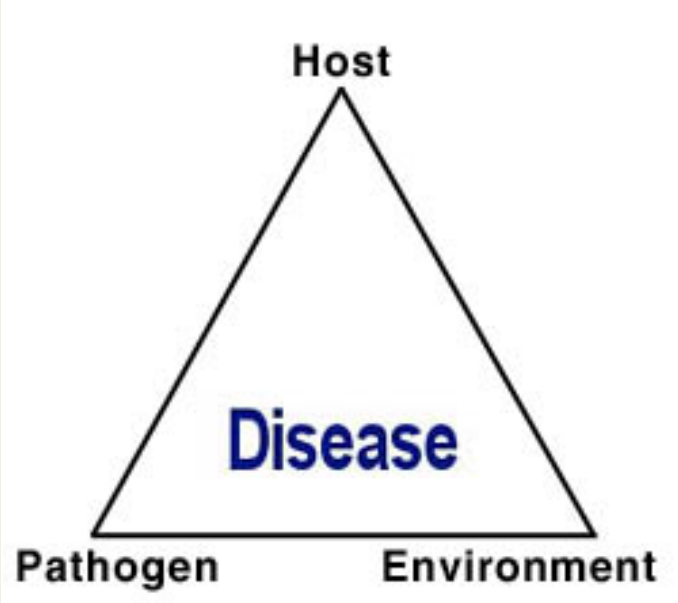


Fig. 1. Possible disease symptoms on plants.

Disease Triangle

- Susceptible Host
- Virulent Pathogen
- Favorable Environment



All three must occur simultaneously!!

DISEASE CONTROL

- Must understand Disease Cycle
- 5 Step Process:
  - Exclusion
  - Avoidance
  - Eradication
  - Protection
  - Resistance

Biological vs. Non Biological Disease Control

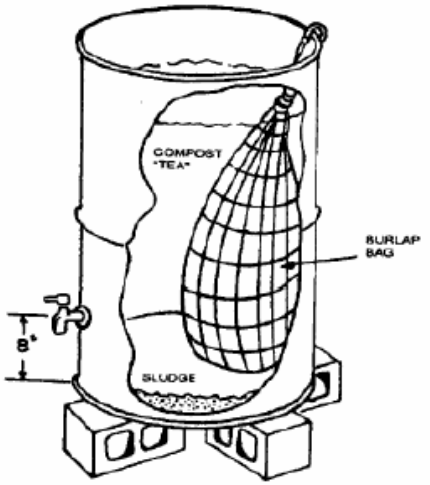
- Man-made chemicals
  - Potential harm to “non-target” species
  - Often require “quarantine” time-period
  - Problems with drift
  - Expensive to apply

- Compost Tea
  - All natural (non-harmful)
  - No quarantine periods
  - Generally topically applied
  - Foliage
  - Root System

Pesticide Drift

What is Compost Tea?

- The liquid portion of compost soaked ("steeped") in water
  - Non-aerated
    - 1 part compost, 3-10 parts water
    - Occasional stirring
    - 1-3 weeks
  - Aerated
    - 1 part compost, 10-50 parts water
    - Air injection or constant circulation for 6-24 hours
    - Often made with additives (molasses, yeast extract, algal powder, kelp) to increase microbial biomass



What does compost tea contain?

- plant nutrients and humic acids
- active bacteria
- active fungi
- protozoa
- nematodes
- products of microbes that can have antibiotic properties

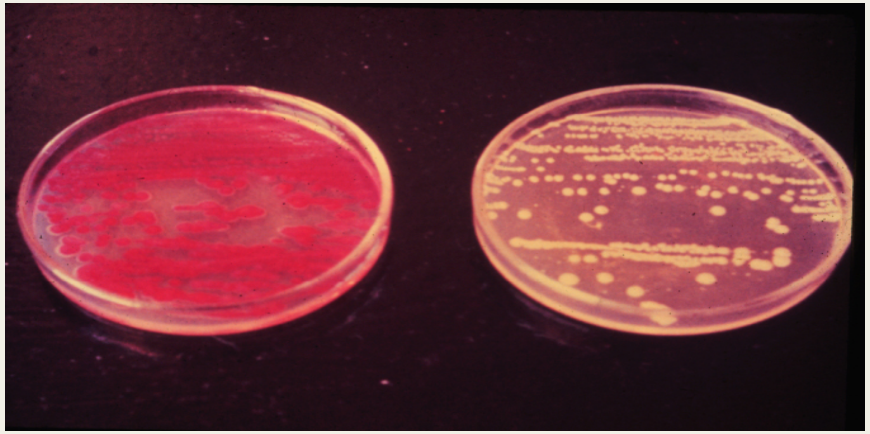


Photo from: Compost Food Web slide show

Why compost tea? Why now?

- Increasing societal concern for health and environment and organic production
- Lack of disease control mechanisms for organic farmers and gardeners
  - Restricting agrochemicals due to recognized toxicity, for example FQPA
- Organic farmers need control methods that work within a holistic system

Compost tea uses

- Foliar fertilizer
- Disease suppression
  - Foliar
  - Soil-borne
- Residue decomposition
- Enhanced soil biology
- Pest suppression

Steve Wright, Pennsylvania vineyard. Rodale Institute Photo.

Benefits of compost tea

- Nutrient application
- Disease control
  - Foliar disease
  - Root disease
- Inoculation of functioning soil food web

How to Achieve Disease Suppression
"One-Two Punch"

- 1st punch
  - In the soil
    - Tea and Compost
- 2nd punch
  - Foliar spray on the plant

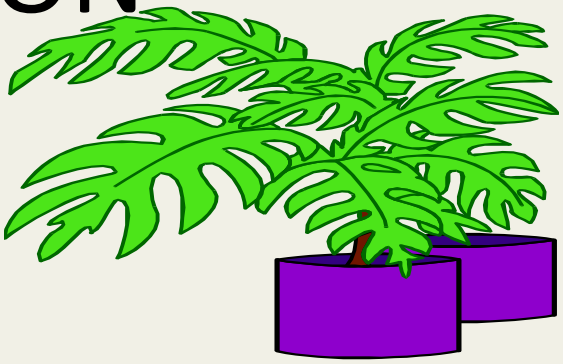
Heating (Pasteurization) will render Compost Tea ineffective at suppressing plant diseases!!

Can compost tea suppress disease?

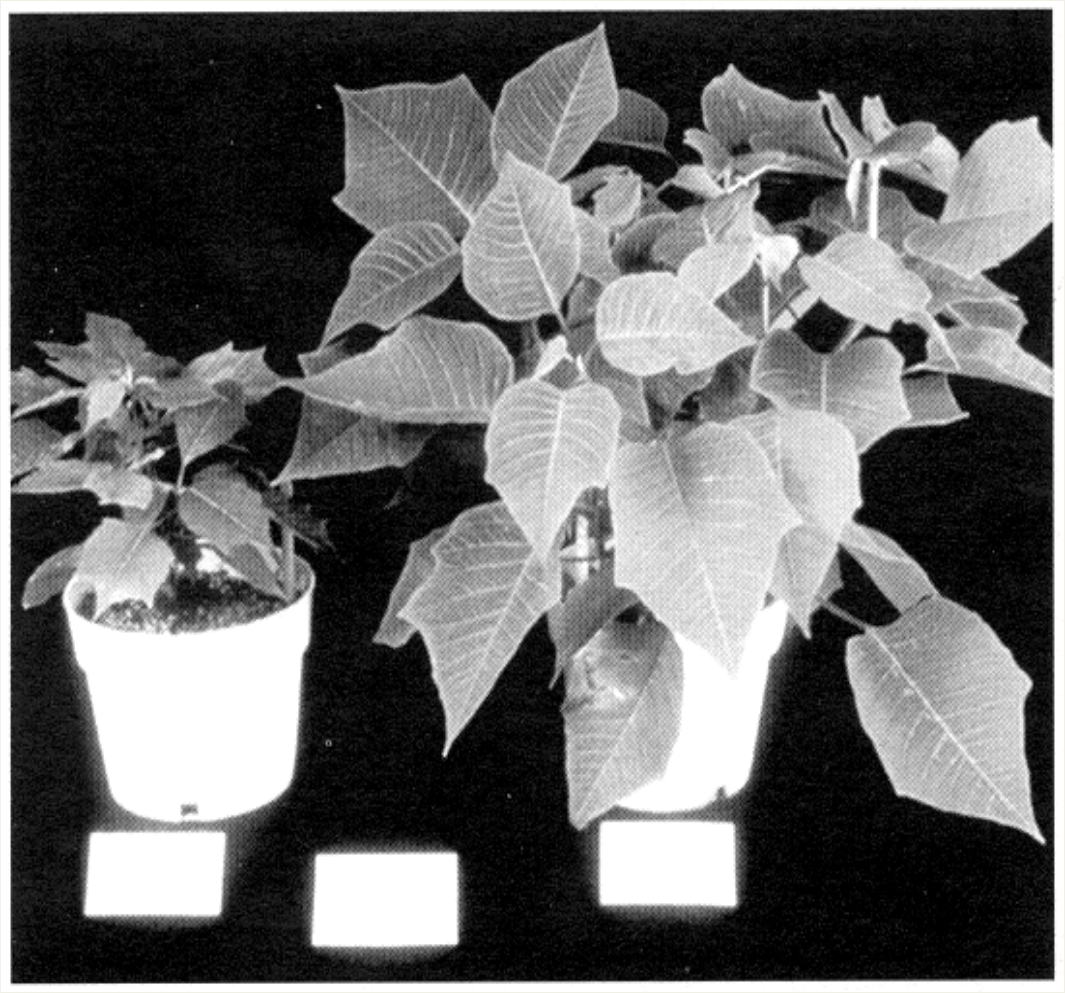
- Yes!
  - Litterick et al. (2004) lists 24 unique crop/pathogen combinations in which disease has been suppressed by compost tea*
    - Tomato early blight, late blight, powdery mildew & bacterial spot
    - Grape leaf blight, grey mould, downy mildew & powdery mildew
    - Strawberry grey mould & redcore
- … and no.
  - Control is unpredictable and sometimes insufficient

*Litterick, A.M.; Harrier, L.; Wallace, P.; Watson, C.A. & Wood, M. 2004. The Role of Uncomposted Materials, Composts, Manures, and Compost Extracts in Reducing Pest and Disease Incidence and Severity in Sustainable Temperate Agricultural and Horticultural Crop Production: A Review. *Critical Reviews in Plant Sciences* **23**(6), 453--479.

PATHWAYS OF SUPPRESSION



- **COMPETITION**
- **ANTIBIOTIC SECRETIONS**
- **PREDATION**
- **INDUCED SYSTEMIC RESISTANCE**
- **GROWTH PROMOTER**



The plant on the right was treated with compost. Both were exposed to Pythium.

Mechanisms of disease suppression

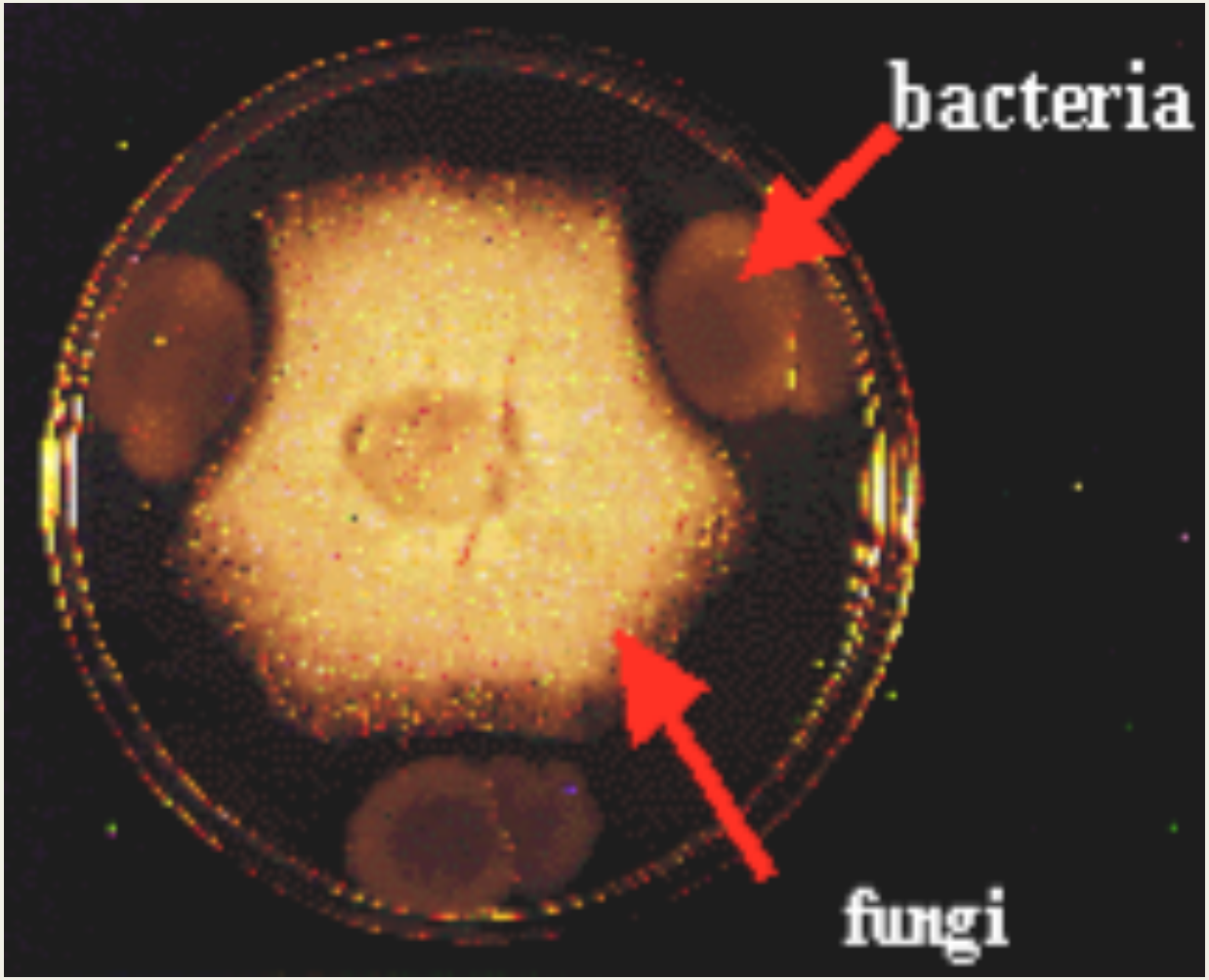
- Competition: organisms compete for resources
  - *Pythium* and *Phytophthora* spp. are susceptible.
- Antibiosis: one organism suppresses another's growth
  - *Trichoderma viride* produces an antibiotic that controls armillaria root rot, pythium and rhizoctonia damping off, and crown gall

Gladis M. Zinati. 2005. Compost in the 20th Century: A Tool to Control Plant Diseases in Nursery and Vegetable Crops. *HortTechnology* 15: 61-66.

Antibiosis: what organisms and metabolites may be involved?

- Bacteria- *Bacillus, Pseudomonas, Serrantia*
- Yeast- *Sporobolomyces, Cryptococcus*
- Fungi- ***Trichoderma***, *Gliocladium and Penicillium*

Chemicals involved - phenols, amino acids, low molecular weight non-protein (sometimes produced by fermentation and other times already within compost)

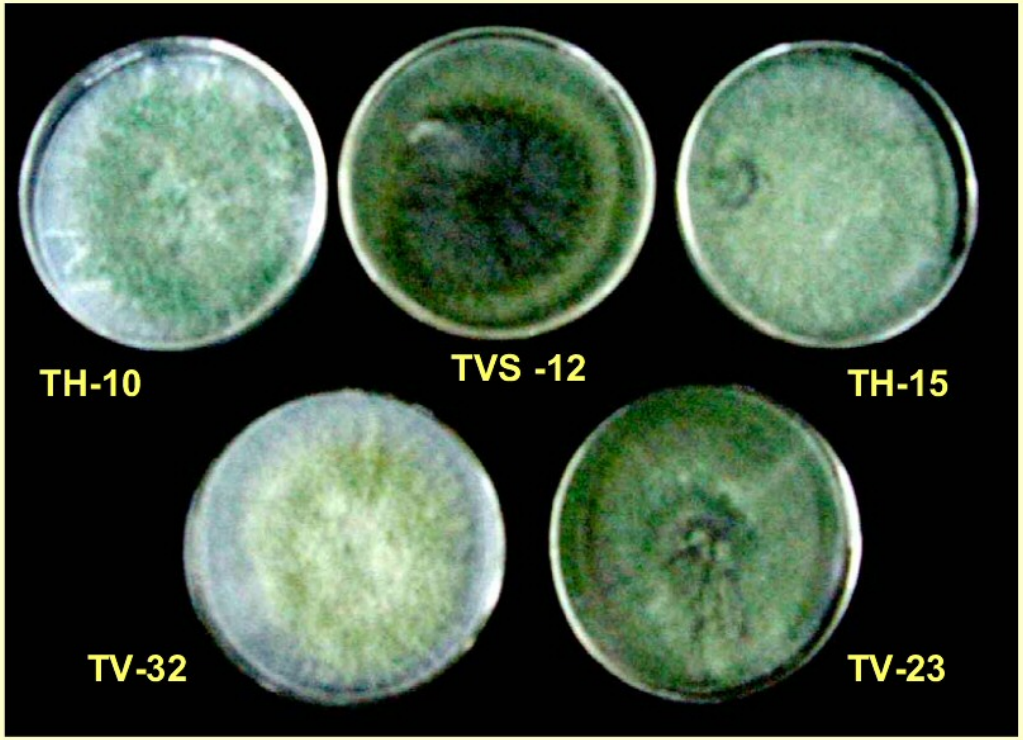


Antagonistic bacteria restricting fungal growth by diffusible toxic compound

Mechanisms of disease suppression

- Parasitism: one organism consumes another
  - Several *Trichoderma* species can eradicate *Rhizoctonia solani* (one of the fungi responsible for damping off)
- Induced systemic resistance
  - More plant defense compounds produced when cucumbers grown in compost-treated soils

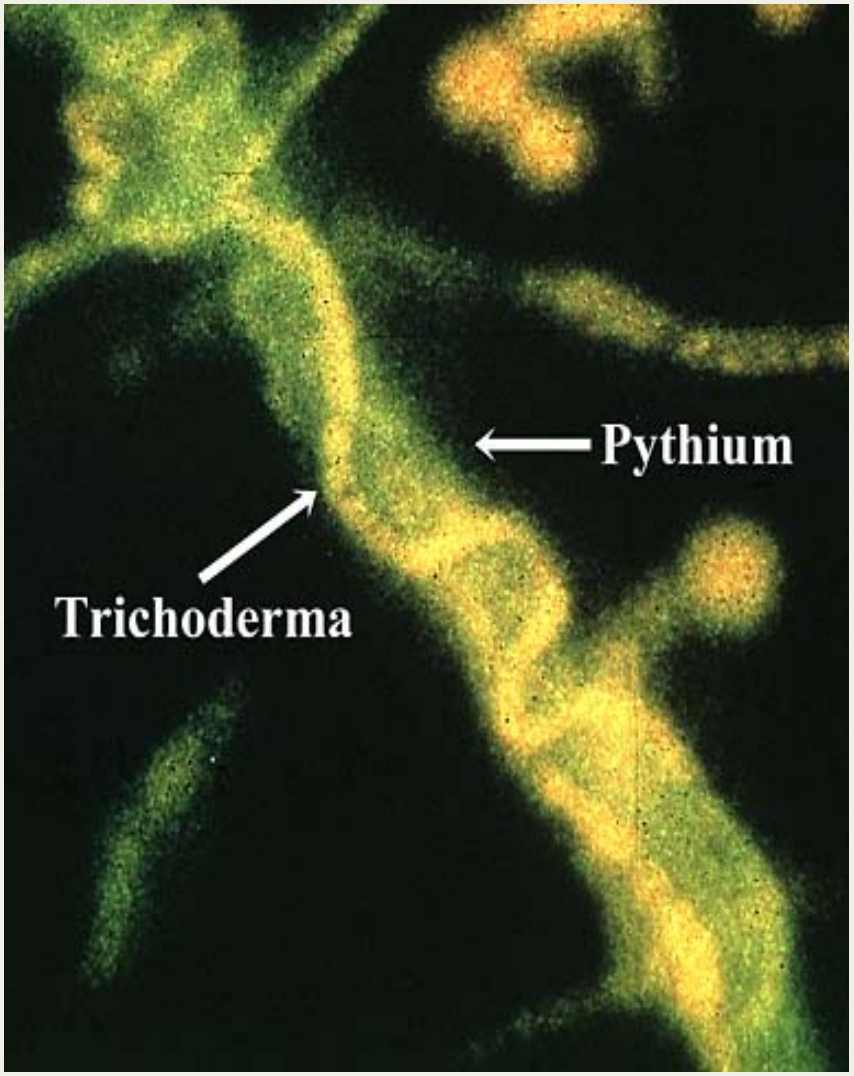
Hoitink et al. 2000. Ohio State University Bulletin 177-01



Promising isolates of *Trichoderma harzianum (T.h)* *Trichoderma viride (T.v)* and *Trichoderma virens (T.vs)*

In vitro* parasitization of *Fusarium oxysporum* f.sp. *gladioli* by *Trichoderma virens.

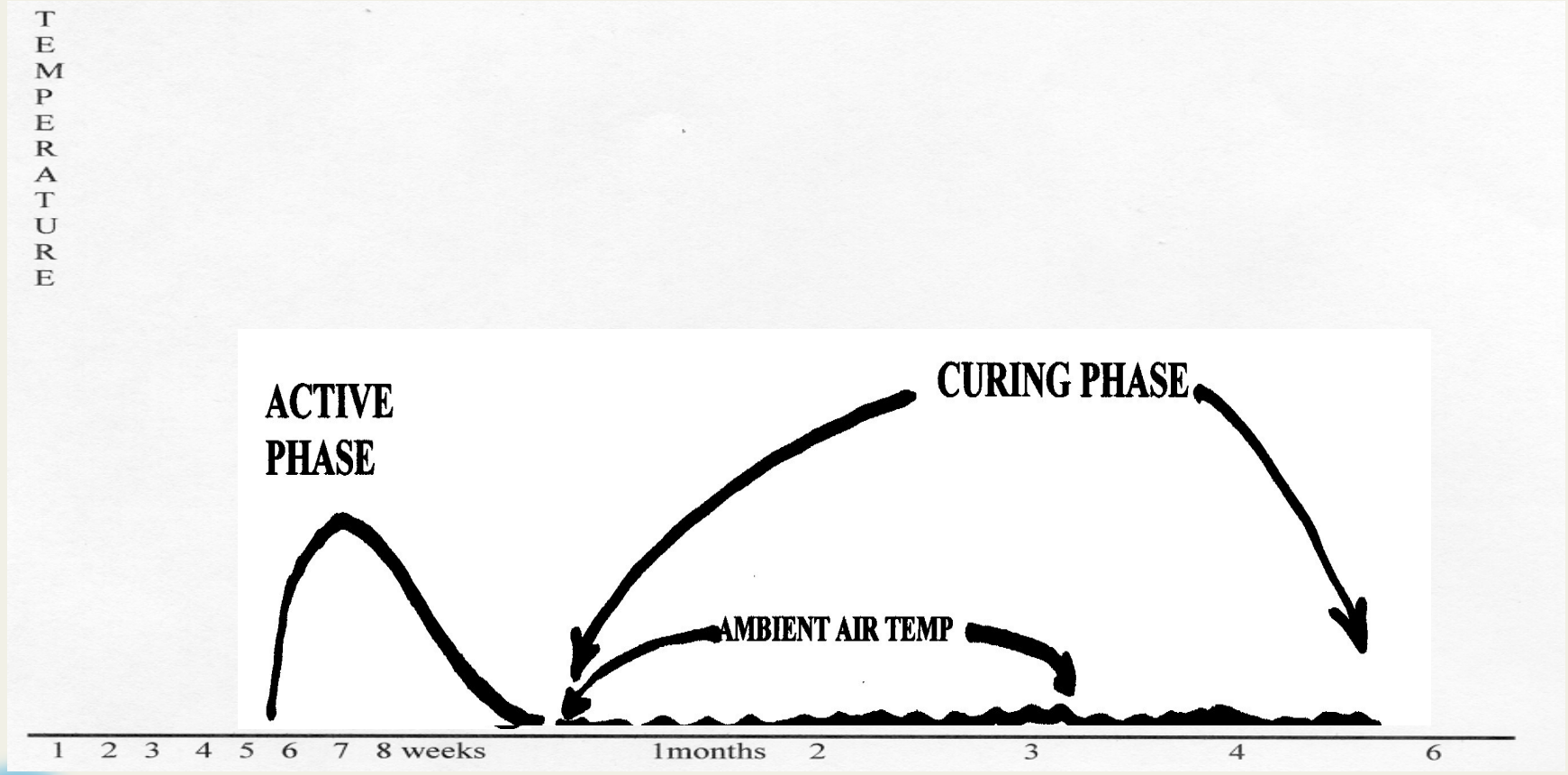
Antagonist overgrows and colonize fusarial colony.



Trichoderma colonizing *Pythium*

Trichoderma punctures in *Rhizoctonia* hypha

TRANSFORMING RAW ORGANICS INTO A MATURE COMPOST



MATURE VS STABLE

- Immature compost can be air dried and be made to look stable (artifically!!)
- Adding moisture and agitating it will renew biological activity.

CAUTION !!!!!!

IMMATURE COMPOST CAN ACT AS AN HERBICIDE


Compost Tea
Leachate

Not to be confused with:

Manure tea made as a nutrient source

Plant material soaking in water, herbal tea preparation

Photos: Eliot Coleman's European tour (Diver 2001)

Stinging nettle herb tea, with BD preps

Plant extracts or herbal teas for disease control or plant health, for example biodynamic preparations

COMPOST TEA RECIPE

- 1 gallon of compost in a permeable cloth.
- 5 gallons of water.
- Soak at least 3 d at 15-25°C (50-70 °F), stir 3 times.
- Surfactant may be added (not sugar-based)
  - --Potential *E. coli* re-growth
  - --Use Tween-20 or Nu-film 117 (Woods End)
- Strain and use as soon as possible.
  - --Coarse filter preferred
- Repeat every 7 days.

Aerated Compost Tea (ACT)

- Oxygen is added via bubbling diffuser during fermentation.
  - **higher costs, energy**
  - **little research, some disease control reports**
- Numerous companies/models for sale:
  - SoSoil Soup:
  - www.soilsoup.com
  - Microb Brewer:
  - www.microbbrewer.com
  - Growing Solutions:
  - www.growingsolutions.com

Compost tea brewing: pumping, trickling, aeration, California

Soil Soup

www.soilsoup.com

6.5-gallon compost tea brewer, Soil Soup

30-gallon compost tea brewer, Soil Soup

Bioblender + compost sack, Soil Soup

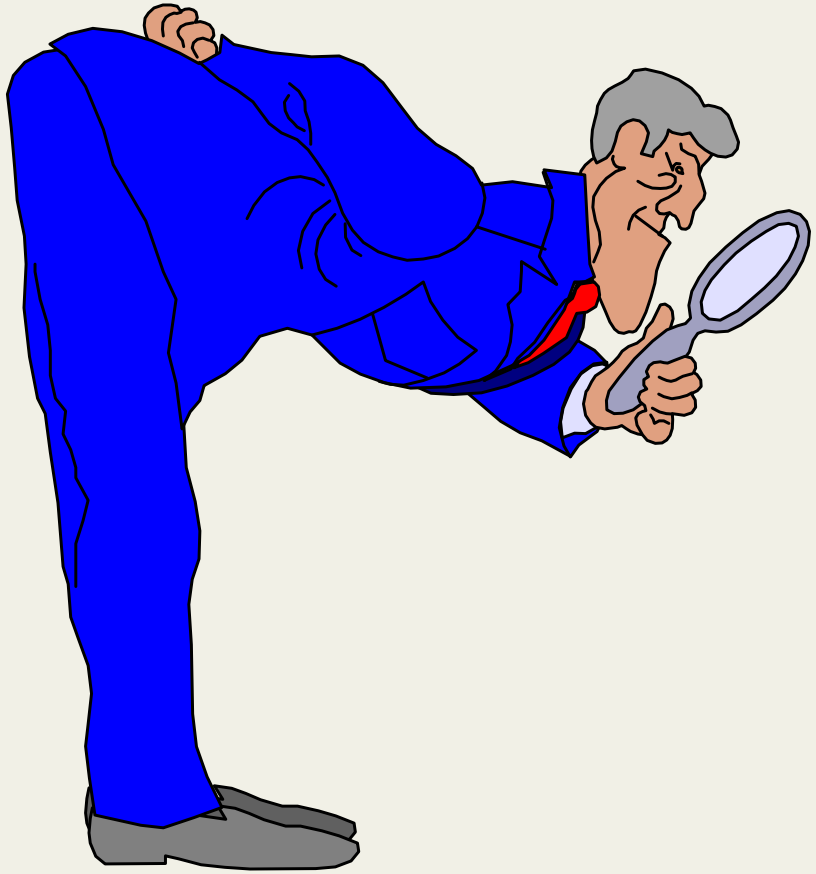
Microb Brewer

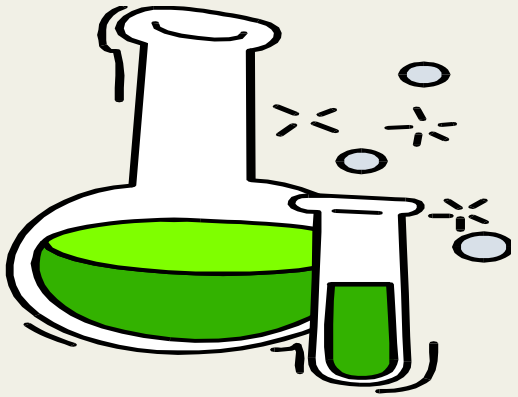
www. microbbrewer.com

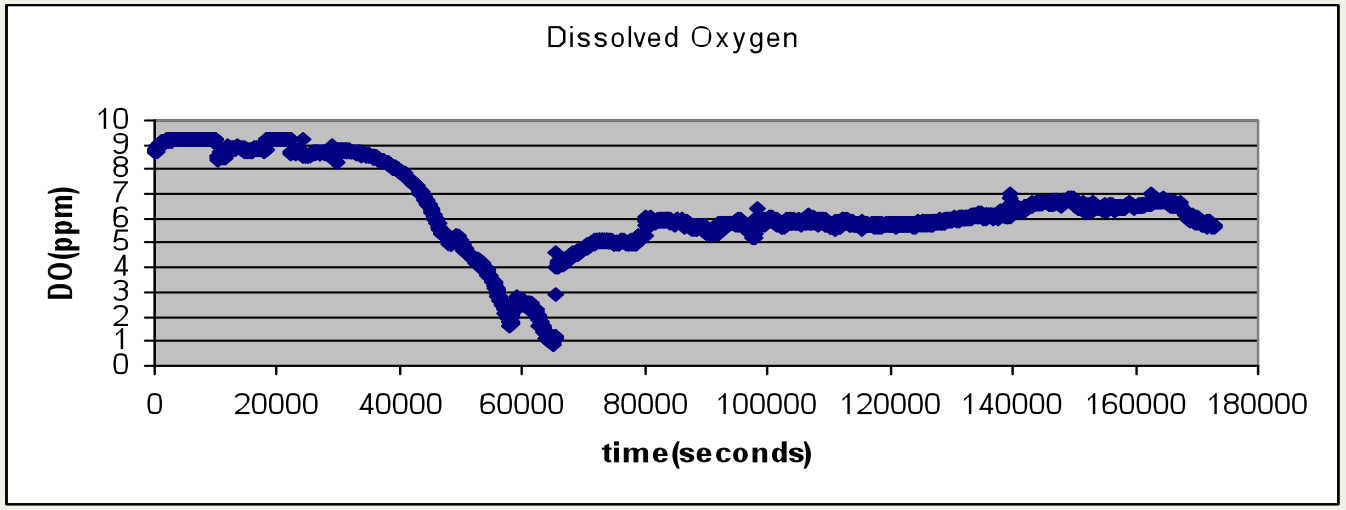
Compost tea leachate basket, Microb Brewer

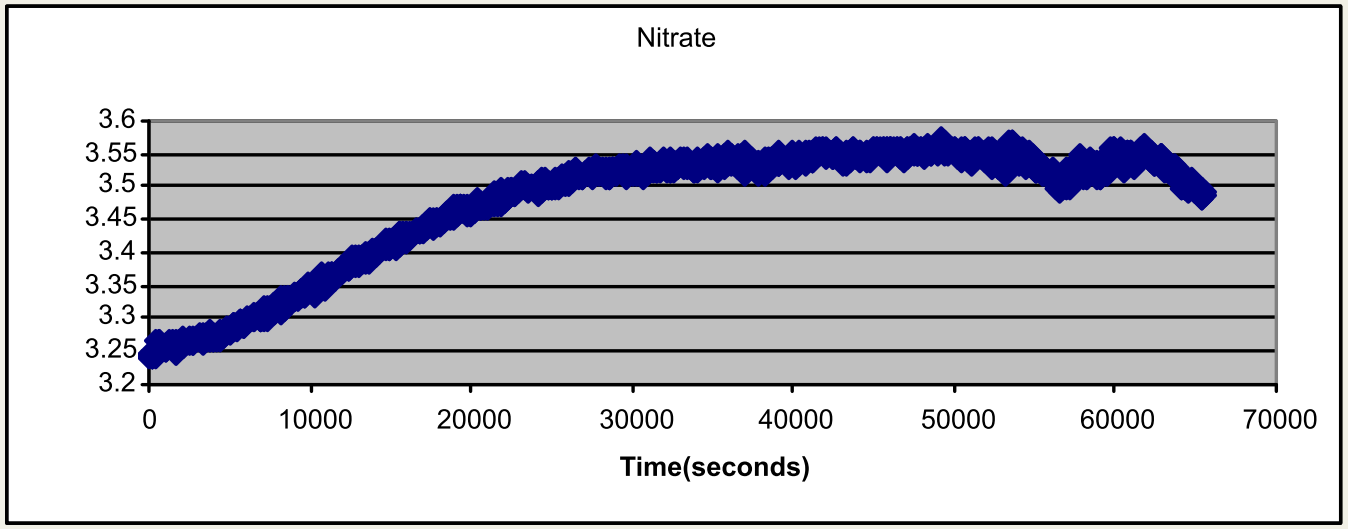
12, 50, 500-gallon compost tea brewers, Microb Brewer

What happens in the compost tea while brewing?









From: Book and Chichester

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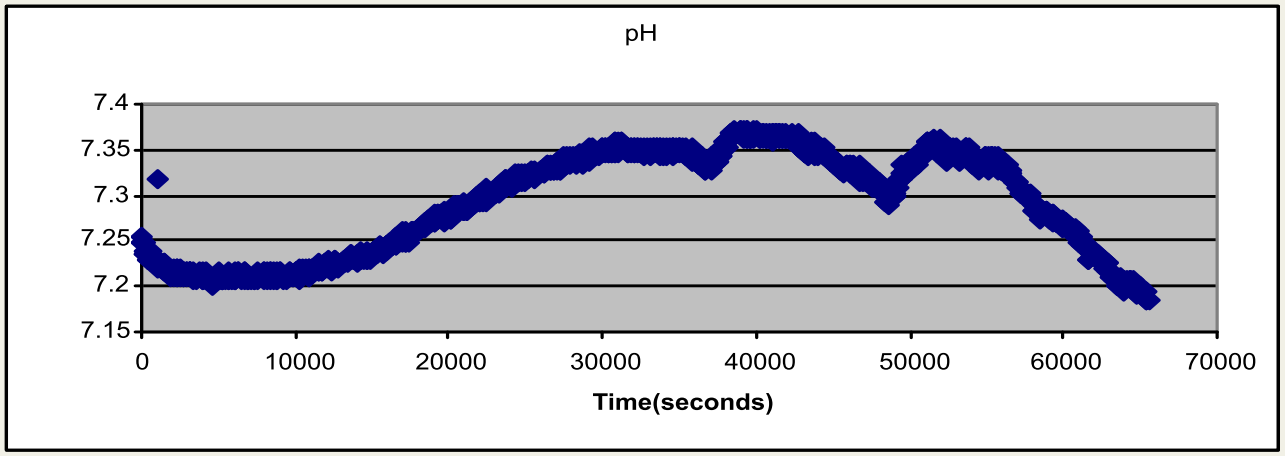

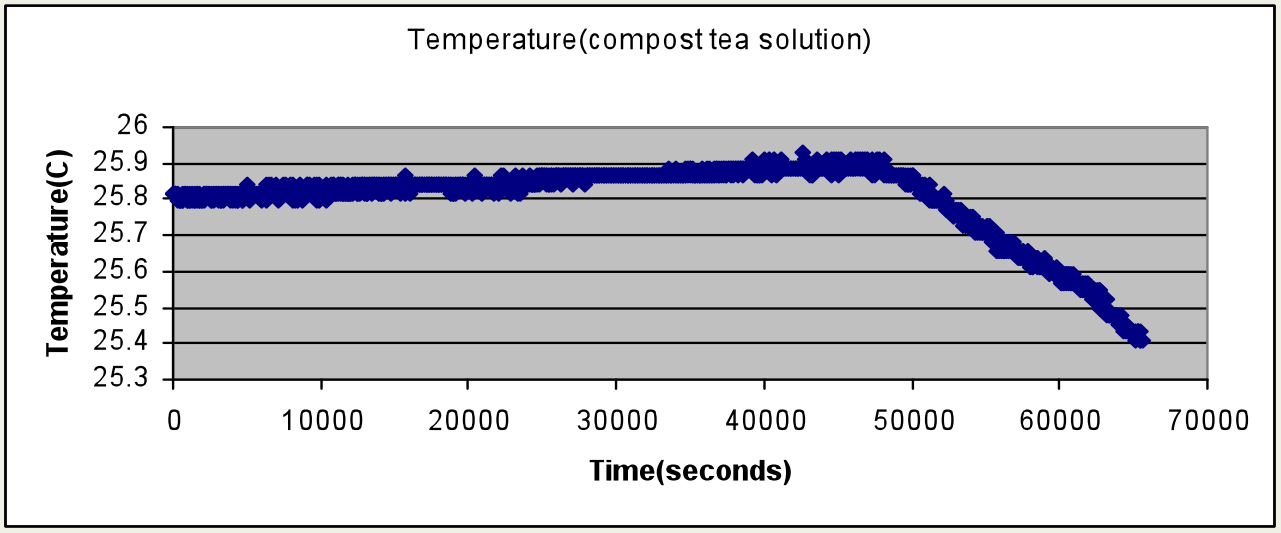

From: Book and Chichester

Making Compost Tea…NOP Recommendations

- Compost Extract-Compost is steeped in water for < 1 hour.

- Compost Tea-Compost is steeped in water for > 1 hour, and…

  - If aerated-10-50 parts water to 1 part compost; aerate for 12-24 hours and use right away.

  - Non-aerated-3-10 parts water to 1 part compost; soak up to 3 weeks (stir ocassionally) and use right away.

Using Compost Tea…NOP Recommendations

- Use NOP recognized compost
- No Restrictions:
  - Compost Tea without additives
  - Compost extracts
  - Compost tea with additives (if meets EPA water quality for E. coli and enterococci.
- 90-120 day pre-harvest restriction:
    - Untested teas or additives
    - Soil applications of raw manure or extracts
- Prohibited:
  - Foliar applications of raw manure/extracts
  - Use of teas for edible sprout production

Compost Teas—Basic Tenants

- **Undiluted watery extracts are prepared 3—10 days before intended use.**
- **Using mature, microbiologically active compost.**
- **Animal manure most effective.**
- **Coarse filtration best, surfactant optional.**
- **Spray as needed and repeat!!**

ANIMAL AND PLANT HEALTH INSPECTION SERVICE

QUESTIONS?

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