# Compost tea:

# Can we *really* turn water into gold ?

Mario Lanthier
CropHealth Advising & Research
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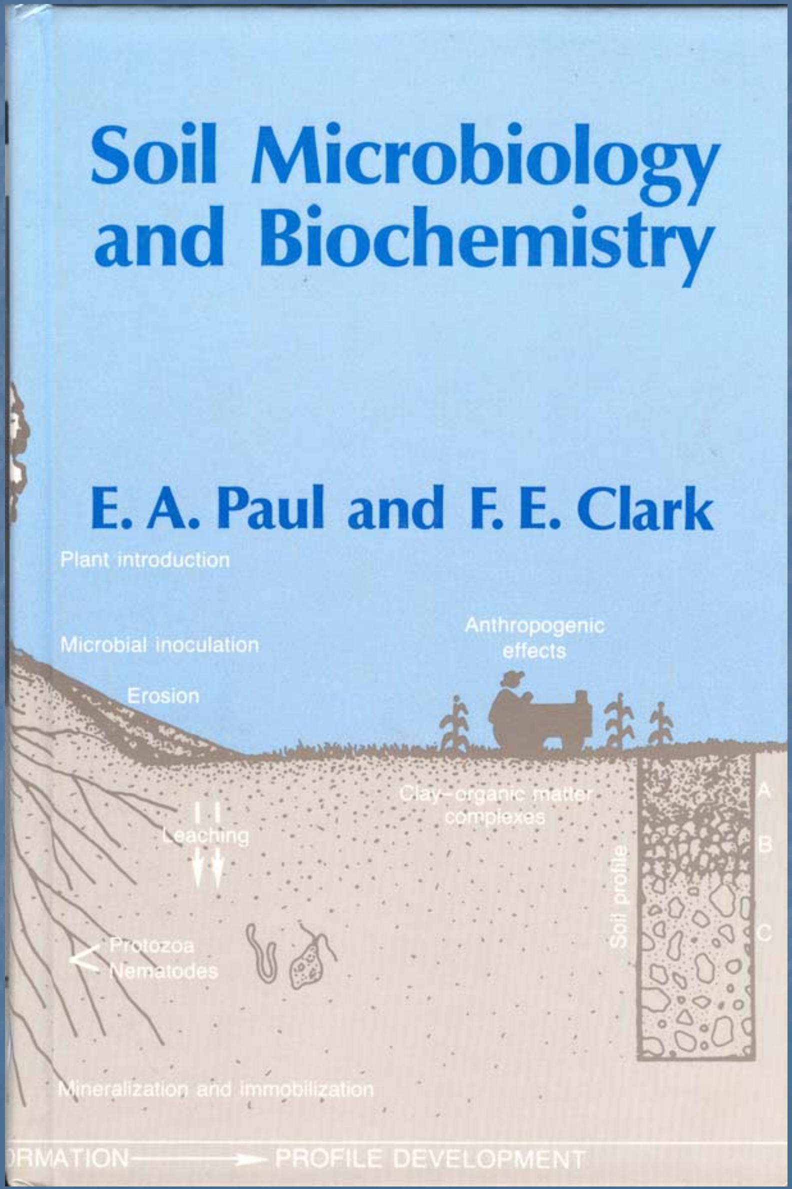
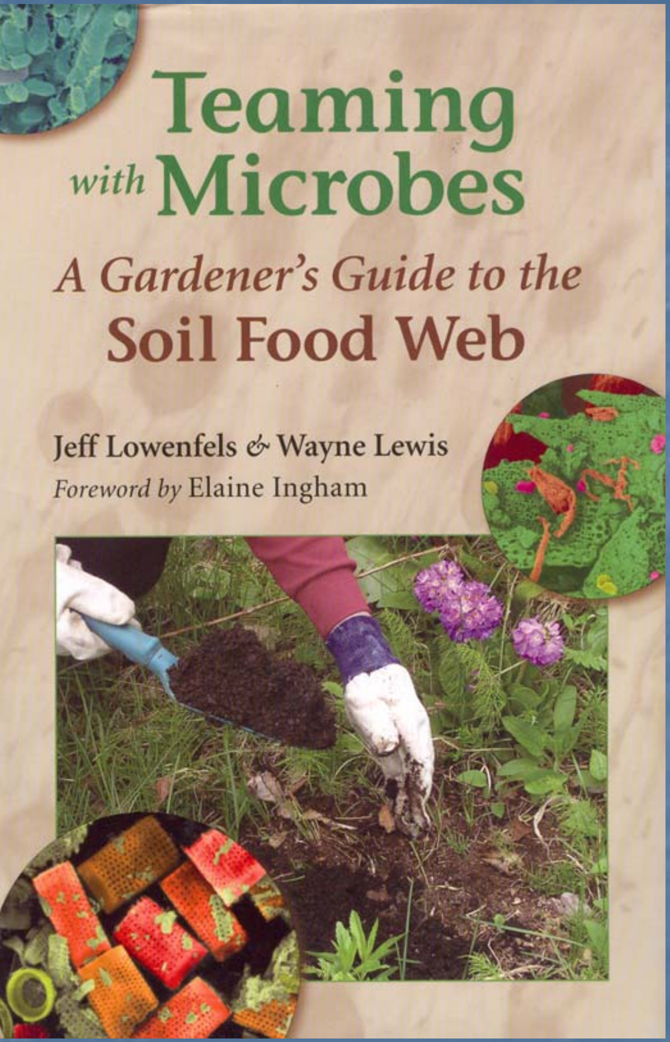
# Compost tea
# and its impact on Soil biology

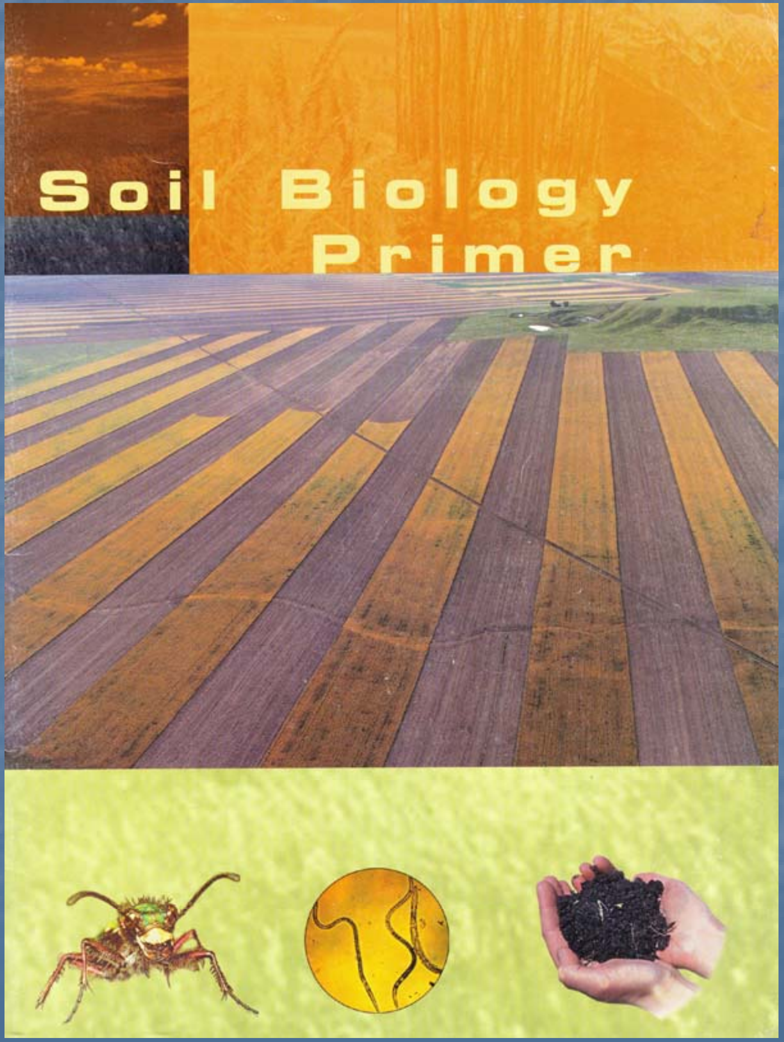
| | |
|---|---|
| 8:30 to 9:45 | Hands-on: Preparing compost tea |
| 10:00 to 11:30 | Soil biology<br>“Recipes” for making tea |
| 11:30 to 12:00 | “Recipes” for using tea |

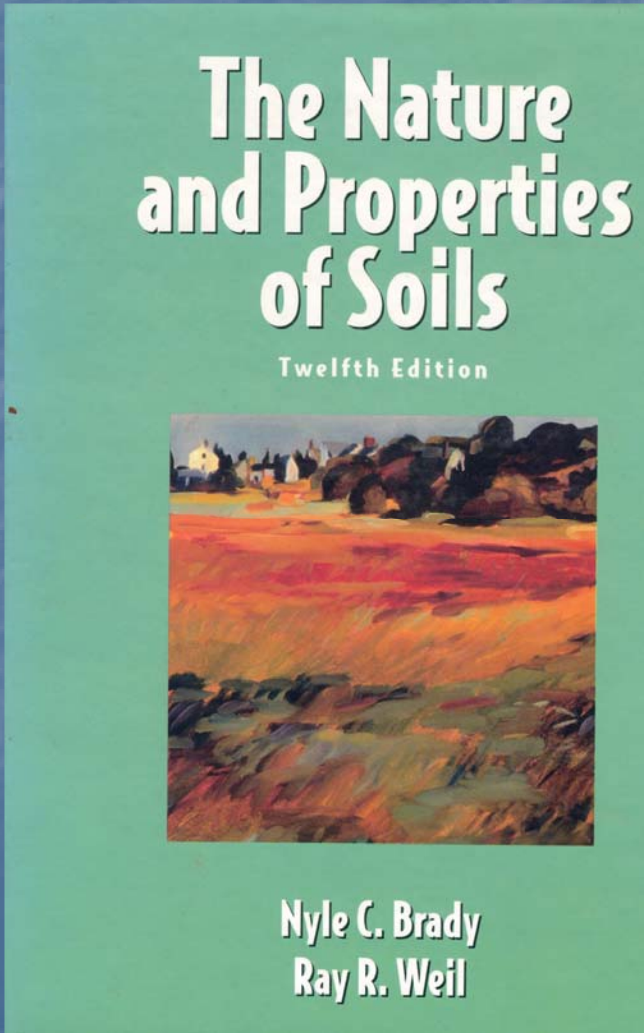
# Tools for today – Hand-outs



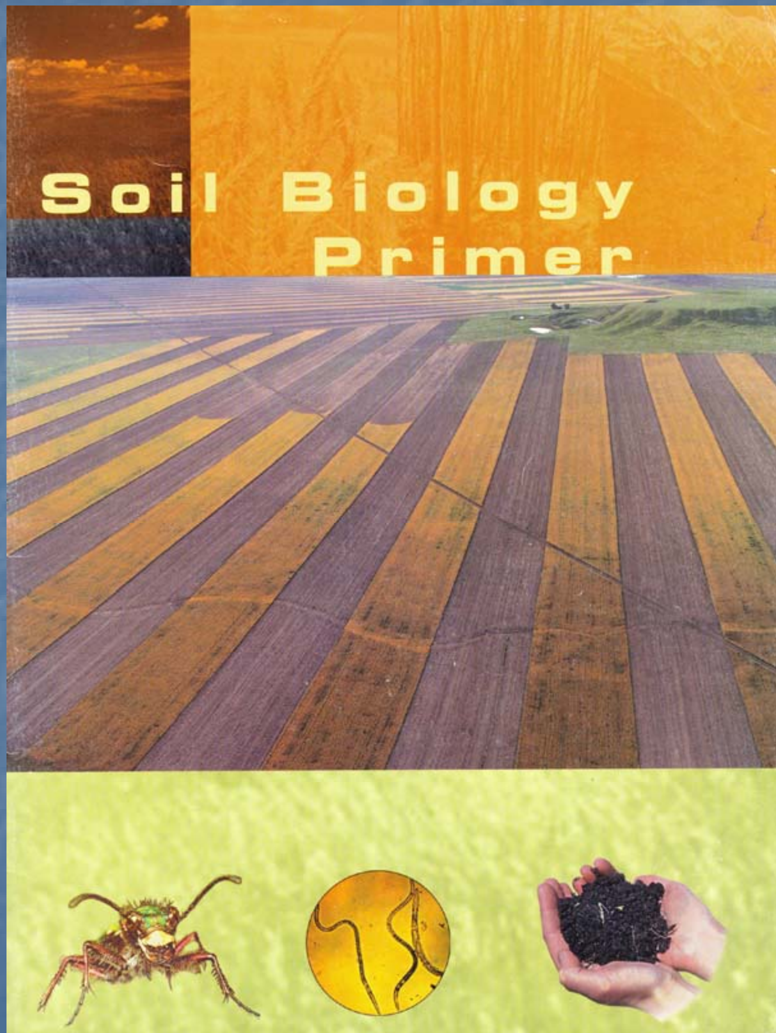

# Tools for today – Great resources



# Publication available for free on the web
# Or purchase a print copy from www.swcs.org




## Soil Fungi

THE LIVING SOIL: FUNGI

Fungi are microscopic cells that usually grow as long threads or strands called hyphae, which push their way between soil particles, roots, and rocks. Hyphae are usually only several thousandths of an inch (a few micrometers) in diameter. A single hypha can span in length from a few cells to many yards. A few fungi, such as yeast, are single cells.

Hyphae sometimes group into masses called mycelium or thick, cord-like "rhizomorphs" that look like roots. Fungal fruiting structures (mushrooms) are made of hyphal strands, spores, and some special structures, like gills, on which spores form (Figure 6). A single individual fungus can include many fruiting bodies scattered across an area as large as a baseball diamond.

Fungi perform important services related to water dynamics, nutrient cycling, and disease suppression. Along with bacteria, fungi are important as decomposers in the soil food web. They convert hard-to-digest organic material into forms that other organisms can use. Fungal hyphae physically bind soil particles together, creating stable aggregates that help increase water infiltration and soil water-holding capacity.

J.P. Martin

**Figure 2:** Fungus beginning to decompose leaf veins in grass clippings.

### How Fungi Enhance Soil Quality

- *Decompose complex carbon compounds*
- *Improve accumulation of organic matter*
- *Retain nutrients in fungal biomass, reducing leaching of nutrients out of the root zone*
- *Physically bind soil particles into aggregates*
- *Are an important food source for other organisms in the food web*
- *Improve plant growth when mycorrhizal fungi become associated with the roots of some plants*
- *Compete with plant pathogens*
- *Decompose certain types of pollutants*

Randy Molina

**Figure 1:** Many plants depend on fungi to help extract nutrients from the soil. Tree roots (brown) are connected to the symbiotic mycorrhizal structure (bright white) and fungal hyphae (thin white strands) radiating into the soil.

SOIL BIOLOGY PRIMER 22

# Using compost tea in agriculture

## Sheppard in vegetables (Oregon) and Sonja in organic apples (B.C.)

# Using compost tea in landscapes

## Ground up Services (Oregon) and Organic Soil Solutions (Ontario)

# Using compost tea in urban areas

Texas State Highway Department (ISA conference, Portland OR, 2012)

# Compost tea is applied after planting of trees

# Nick at Lawn Jockey (Washington State)

# Sheena at Creative Gardens (Seattle)

# These people are using compost tea.  Why ?

# Why use compost tea ?

Compost Science & Utilization, (2002), Vol. 10, No.4, 313-338

LITERATURE REVIEW

## Compost Tea: Principles and Prospects For Plant Disease Control

Steve Scheuerell[1] and Walter Mahaffee[2]
1. Dept. of Botany and Plant Pathology, Oregon State University, Corvallis, Oregon;
2. USDA-ARS Horticulture Crops Research Laboratory, Corvallis, Oregon

An increasing body of experimental evidence indicates that plant disease can be suppressed by treating plant surfaces with a variety of water-based compost preparations, referred to in the literature as watery fermented compost extracts or compost teas. The terms nonaerated compost teas (NCT) and aerated compost teas (ACT) are used in this review to refer to the common production methods that diverge in the intent to actively aerate. Very little data directly compares the efficacy of NCT and ACT for plant disease suppression. A variety of foliar plant pathogens and/or diseases have been suppressed by applications of NCT while few controlled studies have examined ACT. For some diseases the level of control would be considered inadequate for conventional agriculture; organic producers with limited control options consider partial disease control to be an important improvement. For both compost tea production methods, decisions that influence pathogen suppression include choice of compost feedstocks, compost age, water ratio, fermentation time, added nutrients, temperature and pH. Application technology choices include the dilution ratio, application equipment, timing, rates, spray adjuncts and adding specific microbial antagonists. Increased understanding of compost tea microbiology and the survival and interactions of microbes on plants surfaces should make it possible to modify compost tea production practices and application technology to optimize delivery of a microflora with multiple modes of pathogen suppression. Innovative growers and practitioners are leading the development of new compost tea production methods and uses, generating many potential research opportunities. The use of compost tea as part of an integrated plant health management strategy will require much additional whole systems research by a cohesive team of farmers and experts in composting, plant pathology, phyllosphere biology, molecular microbial ecology, fermentation science, plant physiology, plant breeding, soil science, and horticulture.

***Introduction***

S. Scheuerell and W. Mahafee
Oregon State University
Compost Science & Utilization
2002

- To introduce beneficial microorganisms
- To improve plant growth
- To prevent diseases (damping off, Botrytis mold)

But success depends on a number of factors.

# Traditional method - Compost tea from steepage

Method of Amigo Cantisano, California, 2001

The IPM Practitioner

Monitoring the Field of Pest Management

Volume XXIII, Number 9, September 2001

## Compost Tea for Organic Farming and Gardening

Photo courtesy Dan Dinelli

**Compost teas can be produced by home gardeners, organic farmers, and others. Here, compost tea is being prepared by the "teabag" method for use on a golf course.**

*By William Quarles*

Gardeners who want to avoid fungicides, golf course superintendents who want to reduce their dependence on chemicals, and organic farmers who must avoid chemical pesticides can all benefit

nutrients in composts can also make plants stronger and more

As well as plant nutrients, compost teas contain microbials, espe-

# Compost tea from Steepage

## Recipe from Amigo Bob, California, 2002

- Set-up
  55 gallon plastic or metal barrel
  50 gallons clean water (not chlorinated)

- Ingredients
  10 gallons of quality compost
  0.5 pound Algrow Kelp Extract Powder
  0.5 pound Mermaid's Fish powder
  1 gallon molasses

- The more air the better
  Suspend the compost above the tank

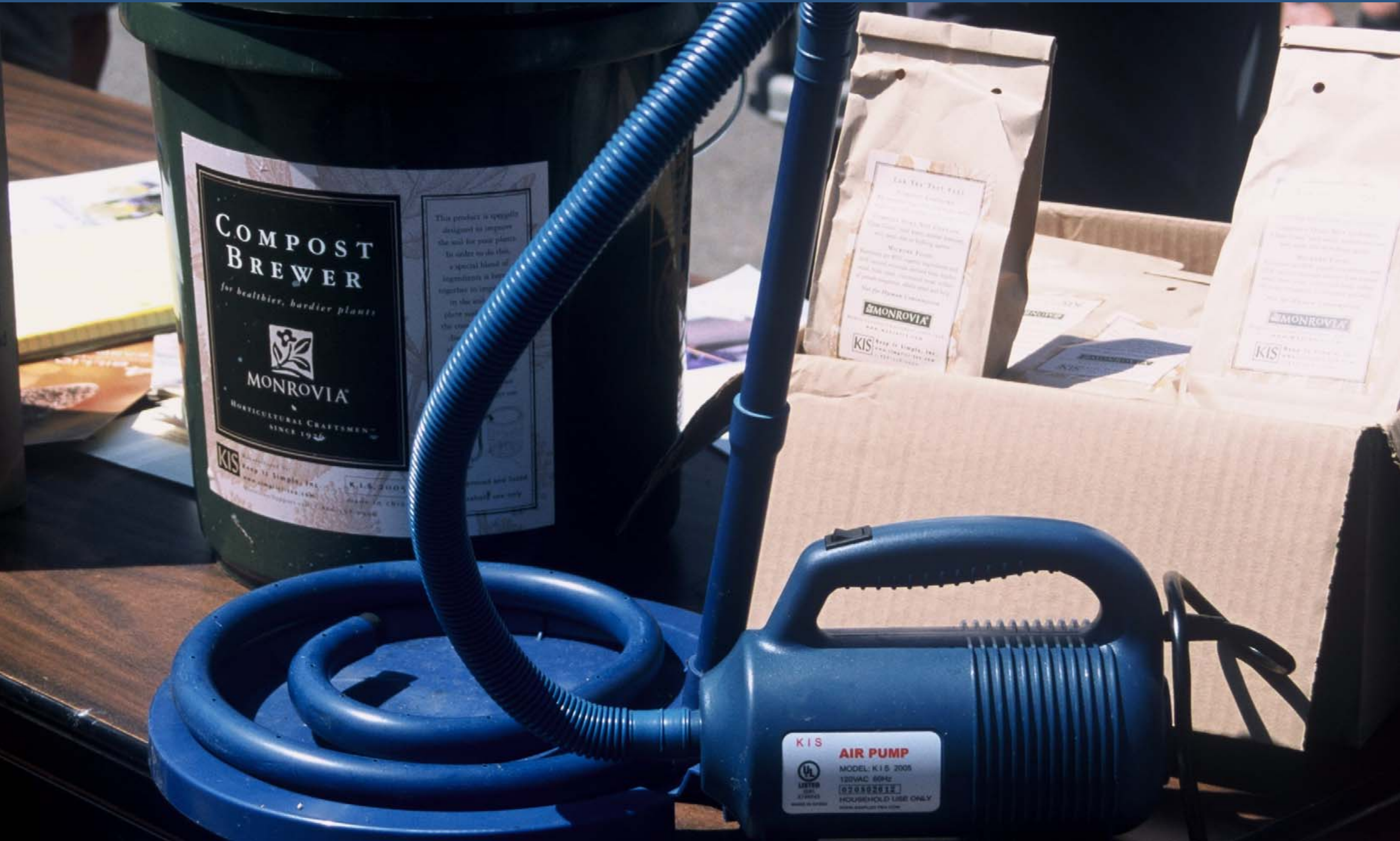
# The new method – Compost tea from aeration

# An early model of compost tea brewer

Earth Tea Brewer
near Portland, Oregon

Note the pipes
with 90º angles

# Commercial machine for home gardeners



# Actively Aerated Compost Tea

## Dr. Elaine Ingham. 2005. Compost Tea Brewing Manual

- Basic recipe for 50 gallons of water

  7 kg of compost
  250 grams of soluble cold-water kelp
  100 ml of plant extract material (yucca, comfrey, etc.)

- Bacterial tea

  Add 500 ml of black strap molasses
  1 to 6 ounces plant extract (yucca, comfrey)

- Fungal tea

  Add 600 ml of humic acids
  250 grams of fish hydrolysate (not emulsion)
  Add mycorrhizal inoculum at the time of spraying

# Note « bacterial tea » and « fungal tea »

- Basic recipe for 50 gallons of water

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- Fungal tea

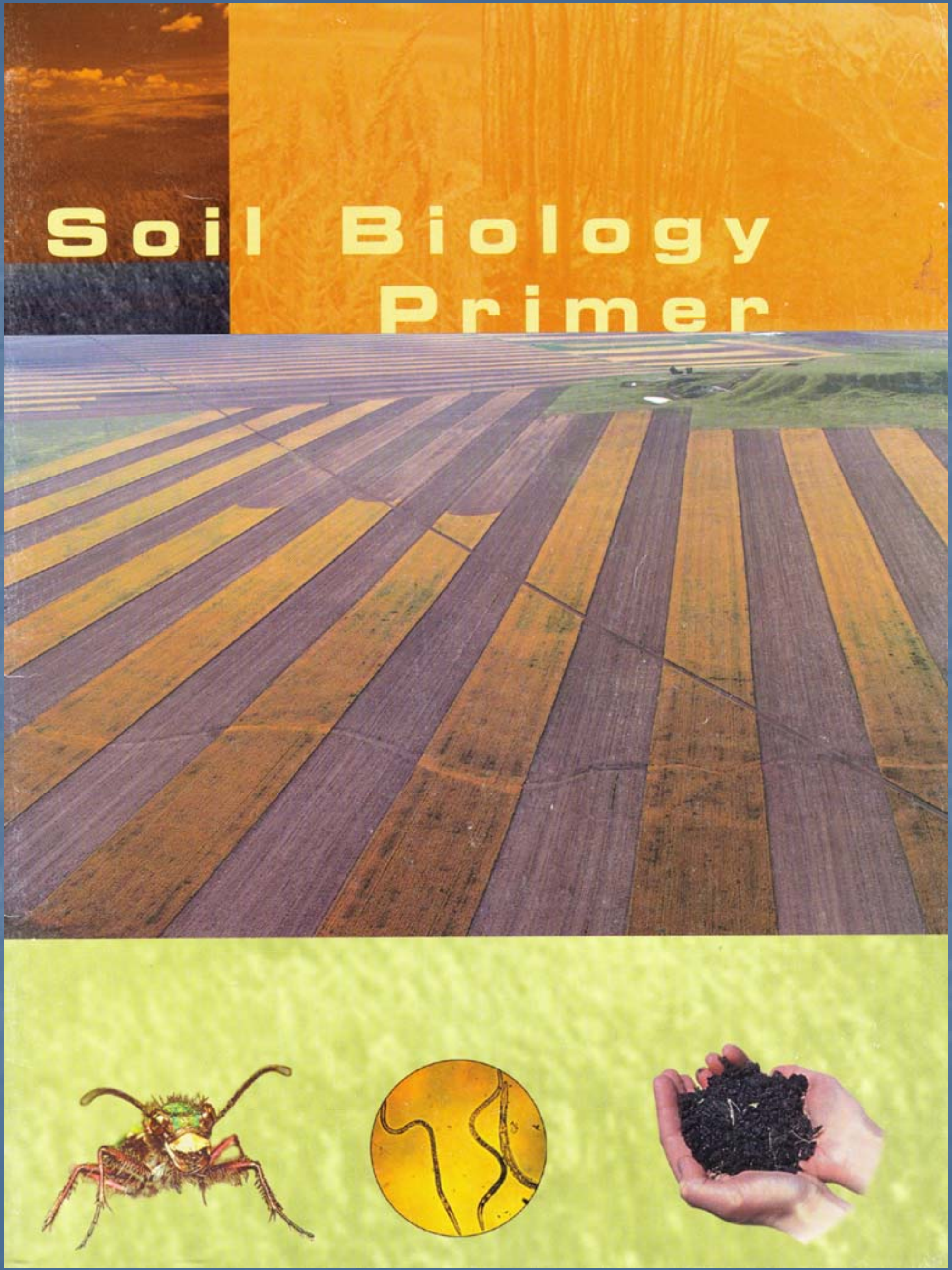
  Add 600 ml of humic acids
  250 grams of fish hydrolysate (not emulsion)
  Add mycorrhizal inoculum at the time of spraying

# Question

What is the difference between "bacterial tea" and "fungal tea" ?

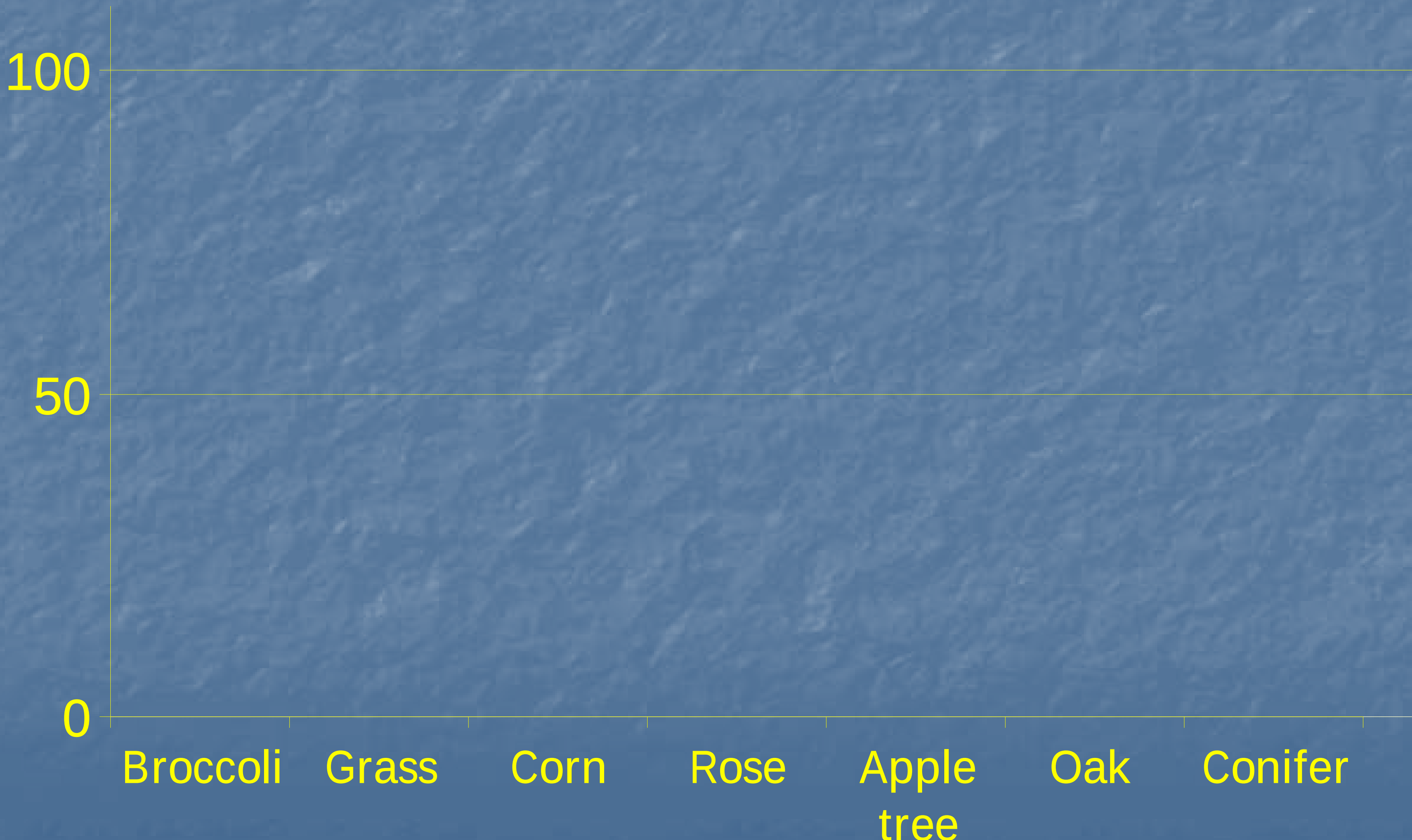
Why should we aim to produce one type of compost tea over another type ?

“Soil Biology Primer”
U.S. Soil and Water Conservation Society
www.swcs.org



# Fungi to bacteria ratios in nature

Dr. E. Ingham, « Soil Biology Primer », 2002



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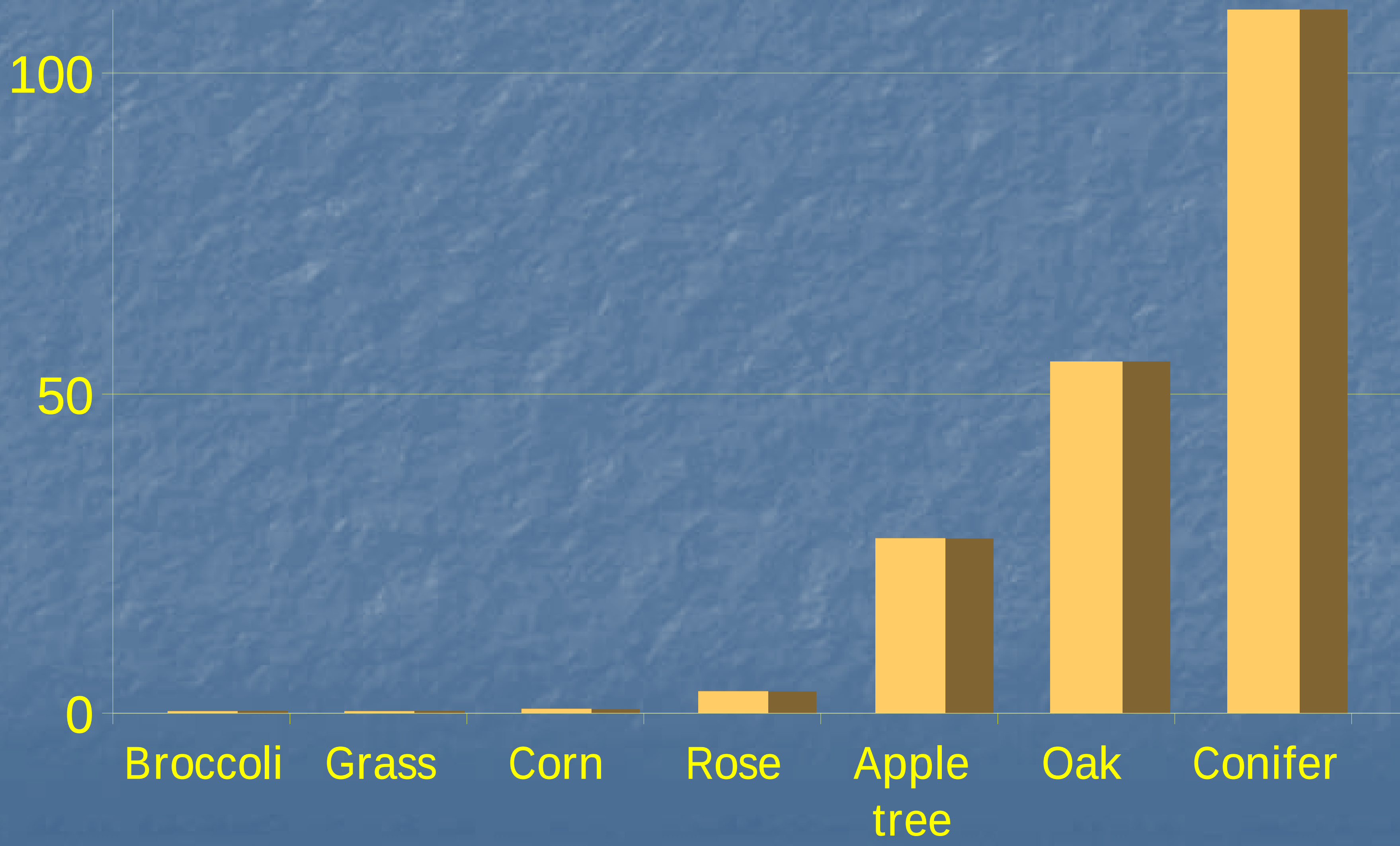


# Soil Microbial Succession

Dr. E. Ingham, Soil Foodweb Inc, 2002

- Bare parent material
  100% bacterial

- Weedy fields and early grasses
  Fungi to bacteria ratio of 0.1 to 0.3 (rich in bacteria)

- Grasses, vegetables
  Vegetables: fungi to bacteria ratio of 0.75
  Row crops: fungi to bacteria ratio of 1:1

- Shrubs and trees
  Shrubs and vines: fungi to bacteria ratio of 2 to 5
  Deciduous trees: fungi to bacteria ratio of 5 to 100
  Conifers and old-growth forest: ratio of 100 to 1,000

In 2004

Sonja Peters brewing compost tea in our lab

What we knew then:

1) Use good quality compost
2) Use good quality water
3) Supply lots of air
4) Use immediately

# Our early teas: lots of variability

Testing at Soil Foodweb Inc., Corvallis Oregon, 2004

| Tea # | Bacteria (biomass in ppm) | Fungi (biomass in ppm) | E. Coli (C.F.U. / ml) |
|---|---|---|---|
| *Target* | | | |
| Tea #1 | | | |
| Tea #2 | | | |
| Tea #3 | | | |
| Tea #4 | | | |
| Tea #5 | | | |

# Our early teas: lots of variability

Testing at Soil Foodweb Inc., Corvallis Oregon, 2004

| Tea # | Bacteria (biomass in ppm) | Fungi (biomass in ppm) | E. Coli (C.F.U. / ml) |
|---|---|---|---|
| *Target* | *150 - 3000* | *2 - 20* | *< 3.2* |
| Tea #1 | 3,968 | 0.31 | 9,680 |
| Tea #2 | 4,992 | 12.8 | 1,810 |
| Tea #3 | 8,320 | 57.4 | 0.0 |
| Tea #4 | 1,184 | 0.62 | 0.0 |
| Tea #5 | 3,456 | 12.2 | 0.0 |

# Sonja Peters in our laboratory

## Comparative brewing from 2006 to 2009

# Compost tea recipe
## Our best attempt

- Water

  15 to 20 liters, any source, aerate to remove chlorine

- Compost

  1 liter (500 grams) + Worm castings 0.5 L (285 grams)

- Other ingredients

  Humic extract 30 ml
  Kelp (cold-water source) 30 ml
  Fish fertilizer 15 ml

- Brew for 5 hours, then remove ingredients

  Continue brewing another 15 hours

# Let’s examine some results from our brewings

# Samples are examined after dilution plating, epifluorescent staining then a light microscope


# Results for same recipe, same machine

K.I.S. brewer, Standard recipe, Results from Soil FoodWeb Canada, January to April 2006

| Date | Bacteria (total, ppm) | Fungi (total, ppm) | Flagellate (# / ml) | Amoeba (# / ml) | Ciliate (# / ml) |
|---|---|---|---|---|---|
| 16 Jan | | | | | |
| 23 Jan | | | | | |
| 6 Feb | | | | | |
| 13 Feb | | | | | |
| 27 Feb | | | | | |
| 06 Mar | | | | | |
| 20 Mar | | | | | |
| 27 Mar | | | | | |
| 3 Apr | | | | | |

# Results for same recipe, same machine

K.I.S. brewer, Standard recipe, Results from Soil FoodWeb Canada, January to April 2006

| Date | Bacteria (total, ppm) | Fungi (total, ppm) | Flagellate (# / ml) | Amoeba (# / ml) | Ciliate (# / ml) |
|---|---|---|---|---|---|
| 16 Jan | 7552 | 20 | 13863 | 575 | |
| 23 Jan | 12032 | 25 | 4606 | 8318 | 2 |
| 6 Feb | 7168 | 34 | 5753 | 831 | 4 |
| 13 Feb | 6912 | 44 | --- | --- | --- |
| 27 Feb | 6784 | 39 | 2772 | 831 | 0 |
| 06 Mar | 8704 | 15 | 13863 | 575 | 0 |
| 20 Mar | 6272 | 25 | 31644 | 57536 | 4 |
| 27 Mar | 11520 | 28 | 13863 | 31644 | 4 |
| 3 Apr | 5760 | 27 | 57536 | 4263 | 4 |

# Bacteria is usually high in compost tea

| Date | Bacteria (total, ppm) | Fungi (total, ppm) | Flagellate (# / ml) | Amoeba (# / ml) | Ciliate (# / ml) |
|---|---|---|---|---|---|
| 16 Jan | 7552 | 20 | 13863 | 575 | |
| 23 Jan | 12032 | 25 | 4606 | 8318 | 2 |
| 6 Feb | 7168 | 34 | 5753 | 831 | 4 |
| 13 Feb | 6912 | 44 | --- | --- | --- |
| 27 Feb | 6784 | 39 | 2772 | 831 | 0 |
| 06 Mar | 8704 | 15 | 13863 | 575 | 0 |
| 20 Mar | 6272 | 25 | 31644 | 57536 | 4 |
| 27 Mar | 11520 | 28 | 13863 | 31644 | 4 |
| 3 Apr | 5760 | 27 | 57536 | 4263 | 4 |

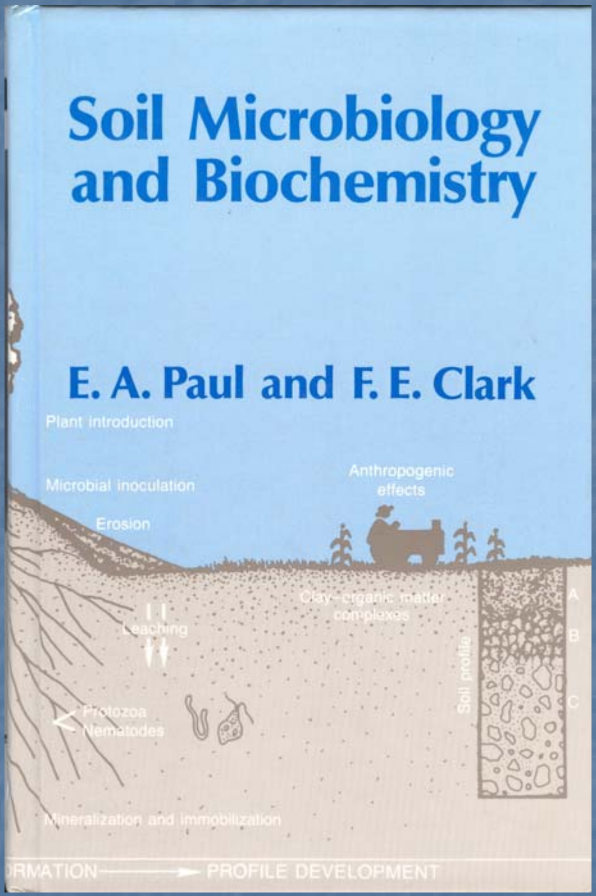
# Team question

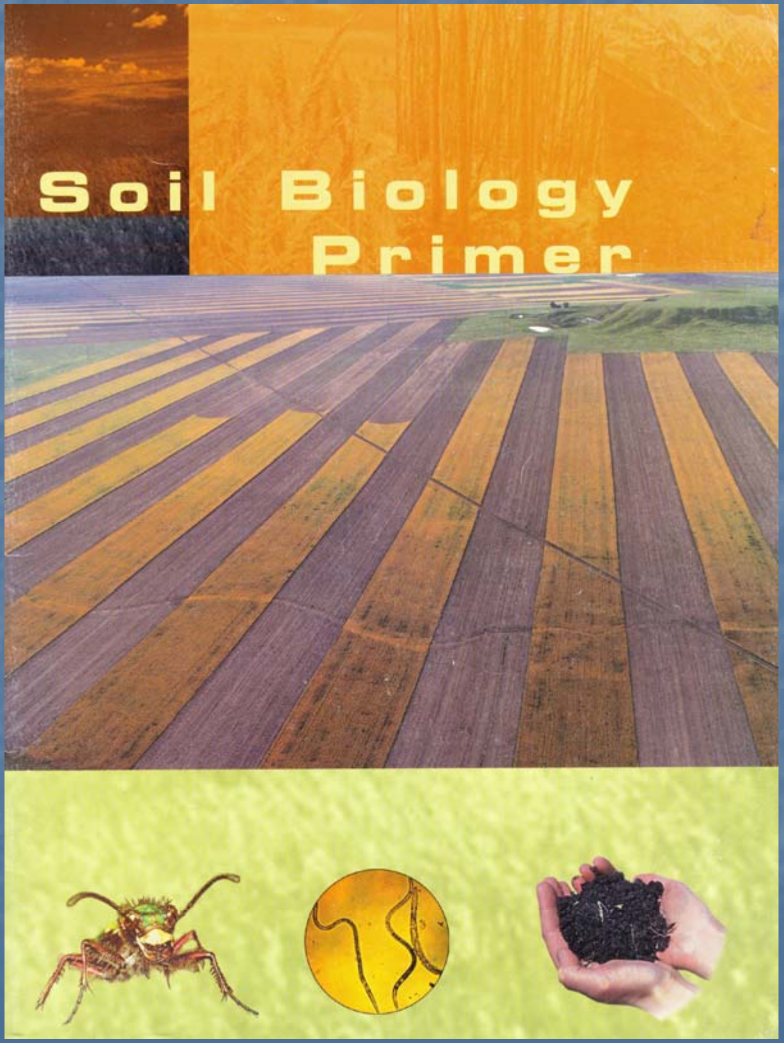
What is the role of bacteria in the soil ?

Can you describe one type of soil bacteria ?

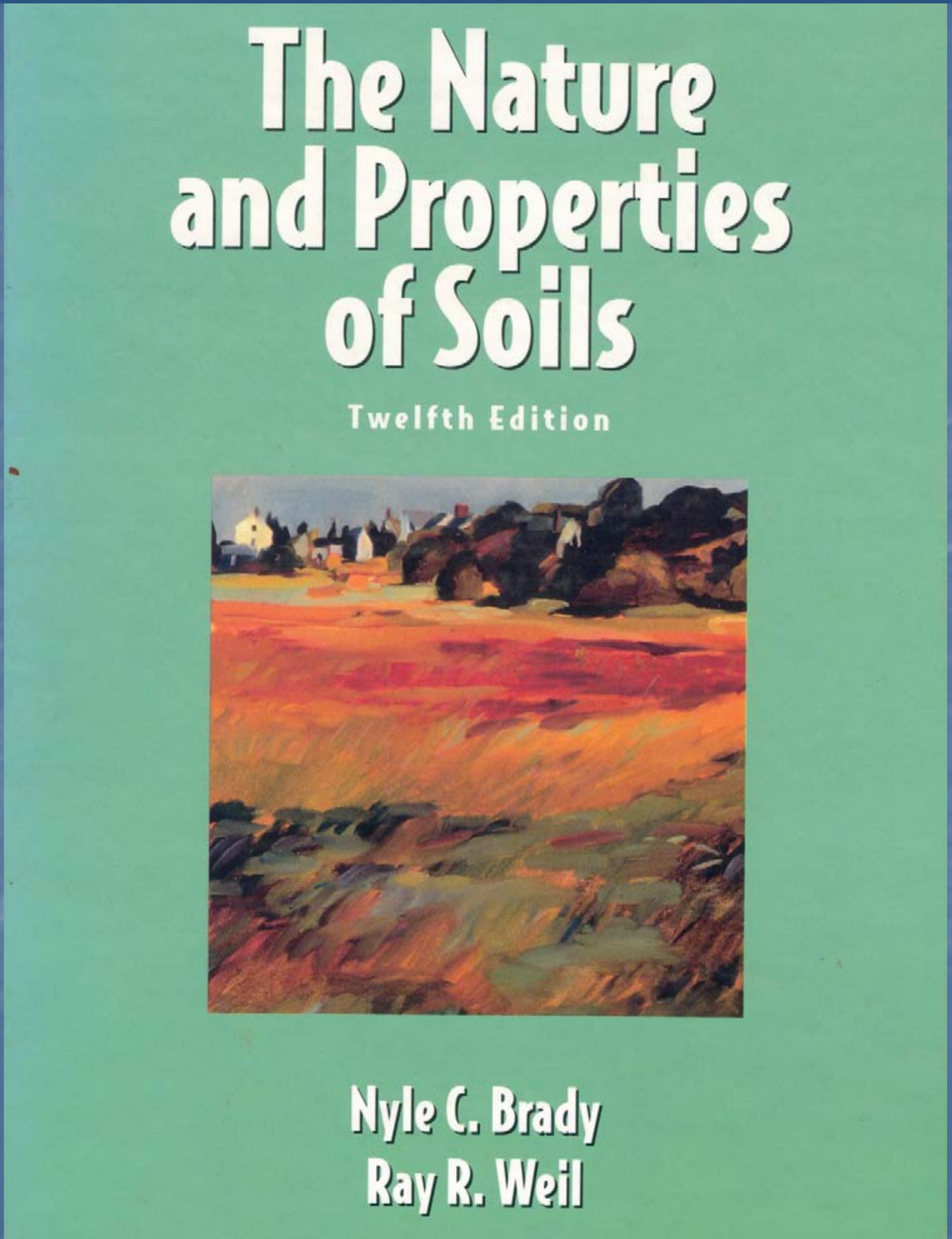
When would we want a “bacterial tea” ?

# Use your resource materials




# What is the role of bacteria in the soil ?




University textbook

12th Edition
1999

# What is the role of bacteria in the soil ?

The Nature and Properties of Soils

“Bacteria are small, single-celled organisms ...
A gram of soil typically contains 20,000 species...
They breakdown organic matter in soil...”

“Bacteria are usually the most important group in the breakdown of hydrocarbon compounds, such as gasoline and diesel fuel.”

Nyle C. Brady
Ray R. Weil

# Ingredients added to aerate compost tea

They are now called "biostimulants"

# 1st World Congress on Biostimulants

November 2012 in Strasbourg, France

# The best review on the science of biostimulants

Available on the web, 32 pages

## The Science of Plant Biostimulants – A bibliographic analysis

Prof. Patrick du Jardin

CONTRACT 30-CE0455515/00-96, « AD HOC STUDY ON BIO-STIMULANTS PRODUCTS »

April 2012 – Final report

# Humic acid, one ingredient in compost tea

Evans and Li. 2003. HortTechnology

"Seedlings grown on HA-treated germination papers had higher dry root weights than those grown on DI or NC-treated germination papers."

# Effect of Humic Acids on Growth of Annual Ornamental Seedling Plugs

M.R. Evans and G. Li

**Additional index words.** bedding plants, humates, roots, substrates, soils

**Summary.** The annual bedding plants 'Dazzler Rose Star' impatiens (*Impatiens wallerana*), 'Cooler Blush' vinca (*Catharanthus roseus*), 'Orbit Cardinal' geranium (*Pelargonium* ×*hotorum*), 'Janie Bright Yellow' marigold (*Tagetes patula*) and 'Bingo Azure' pansy (*Viola tricolor*) were grown on germination papers treated with deionized water (DI), 2500 or 5000 mg·L$^{-1}$ (ppm) humic acid (HA) or nutrient control (NC) solutions. Seedlings grown on HA-treated germination papers had higher dry root weights than those grown on DI or NC-treated germination papers. Except for impatiens, seedlings germinated on HA-treated germination papers had higher lateral root numbers and higher total lateral root lengths than those grown on DI and NC-treated germination papers. Impatiens grown on NC-treated germination papers had higher lateral root numbers than those grown on DI or HA-treated germination papers. Overall, lateral root numbers for impatiens were higher for seedlings germinated on HA-treated papers than DI or NC-treated papers and highest lateral root numbers occurred on those impatiens germinated on papers treated with 5000 mg·L$^{-1}$ HA. Except for geranium, seedlings grown in HA-amended sphagnum-peat-based substrates had similar dry root and dry shoot weights as those grown in unamended substrates. Geranium seedlings grown in HA-amended sphagnum peat-based substrates had significantly higher dry root weights than those grown in unamended substrates. However, dry shoot weights of geranium grown in HA-amended sphagnum peat-based substrates were similar to those grown in unamended substrates.

Department of Horticulture, 315 Plants Sciences Building, University of Arkansas, Fayetteville, AR 72701.

This project was supported by the Bedding Plants Foundation, Inc. and the Arkansas Agricultural Research and Extension Service.

Humic acids have been shown to have numerous effects on plant growth, and the subject has been extensively reviewed by Chen and Aviad (1990). One of the most common responses of plants to HA treatment has been the promotion of root growth. Significant fresh root weight increases were reported (Hartwigsen and Evans, 2000) for 'Bonanza' marigold, 'Salad Bush' cucumber (*Cucumis sativus*), 'Golden Summer Crookneck' squash (*Cucurbita pepo*), and 'Freckles' geranium when grown on HA-treated germination papers. David et al. (1994) examined growth of tomato (*Lycopersicum esculentum*) in solution culture and found increased fresh and dry root weights of plants grown in HA solutions as compared to those grown in control solutions. Mylonas and McCants (1980) reported that tobacco (*Nicotianna tabacum*) plants grown on filter paper saturated with HA solutions had higher root numbers and total root length than plants grown on filter paper saturated with nutrient solutions or deionized water. Tan and Tantiwiramanond (1983) found increased fresh and dry root weights for soybean (*Glycine max*), peanuts (*Arachis hypogea*) and clover (*Trifolium alexandrium*) grown in sand culture amended with HA and fulvic acid. Sanders et al. (1990) examined the effect of HA incorporation into the fluid drill solution used in carrot production and found a 50% to 75% increase in the number of carrot (*Daucus carrota*) seed germinating. Carrot germinated in a substrate drenched with HA had a 100% higher fresh root weight than those germinated in a root medium drenched with water.

Many commercial enterprises produce and market various formulations of HA designed to be used as soil amendments for promoting root growth and stand establishment of crops. Although many of these products list recommendations for the use of HA on annual ornamental plant species, no research has been published regarding the efficacy of HA on annual ornamental plant species. The objectives of this study were to determine the response of various annual ornamental plant species to HA and to determine the potential of HA as a substrate amendment for promoting root growth and stand establishment of annual ornamental plant plugs.

## Materials and methods

**Experiment one: Evaluation of root growth of seedlings grown on HA-treated germination papers.** Treatment solutions included deionized water, HA, and nutrient controls. Humic acid solutions were prepared using the commercial HA product Enersol (American Colloid Co., Skokie, Ill.). Nutrient control solutions that provided equivalent mineral elements contained in each concentration of HA solution were prepared as described by Hartwigsen and Evans (2000). The pH of HA solutions prepared ranged from 8.0 to 9.5. Therefore, to test for potential pH effects, the pH of HA and NC solutions were adjusted to either 9.0 or 7.0 using 0.1 N potassium hydroxide or 0.1 N hydrochloric acid. Solutions were stored in a refrigerator and allowed to warm to room temperature [about 23 °C (73.4 °F)] before use. Fresh solutions were prepared at 14-d intervals.

Two germination paper (Anchor Paper Co., St. Paul, Minn.) systems were used to conduct screenings of different concentrations of HA and NC solutions. The first system was used for vinca, marigold, and geranium because of their relatively large seed size. Each 30 × 30 cm (11.8 inches) germination paper was saturated with 25 mL (0.85 fl oz) of each treatment solution. Five seed were placed along one side of each germination paper about 1 cm (0.4 inch) from the top edge. The papers were rolled and placed in plastic bags and about 10 mL (0.34 fl oz) of solution was placed in the bottom of the plastic bag to serve as a reservoir. Bags were placed upright in a growth chamber. The moisture level of papers was monitored daily and solutions were added as necessary to maintain moist papers. The HA solution concentrations were based upon results obtained by Hartwigsen and Evans (2000) and included HA at 2500 and 5000 mg·L$^{-1}$, their respective nutrient controls, and deionized water.

The second system was used for impatiens and pansy because of their relatively small seed size. Three pieces of circular [10 cm (3.9 inches) diameter] germination paper were cut in half and placed in 10-cm-diameter petri dishes. Three seed were placed along the straight edge of the germination papers about 0.5 cm (0.20 inch) from the top edge. The seed were covered

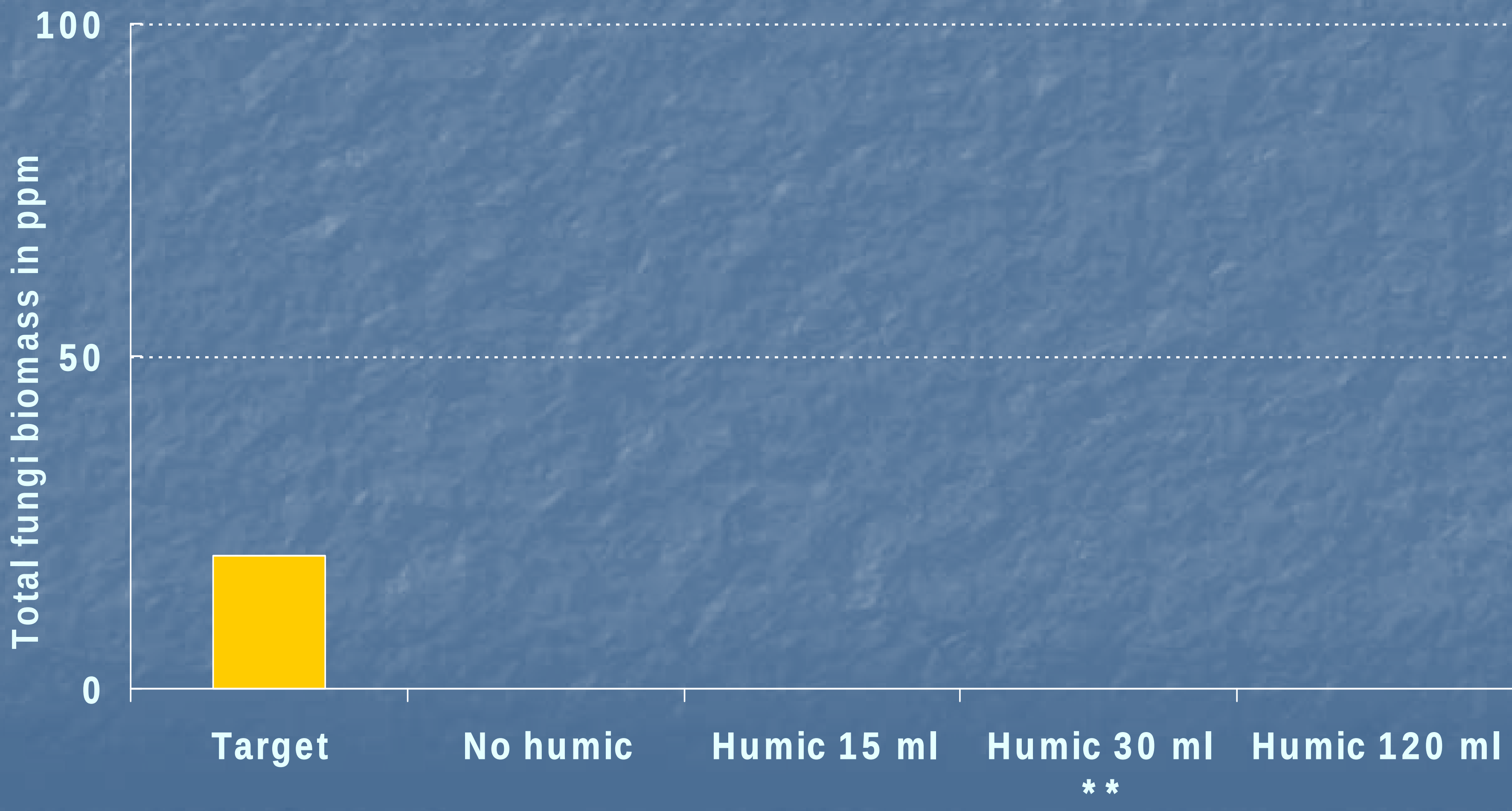
# Back to our comparative brewing...

No humic acid, standard 30 ml, also 50% rate and 4X rate

# Humic acid in compost tea

Impact on total fungi, results from Soil FoodWeb Canada, Jan 2006

Tecologic Multi-dynamic Humic extract in Bob's Brewer 5 gallon



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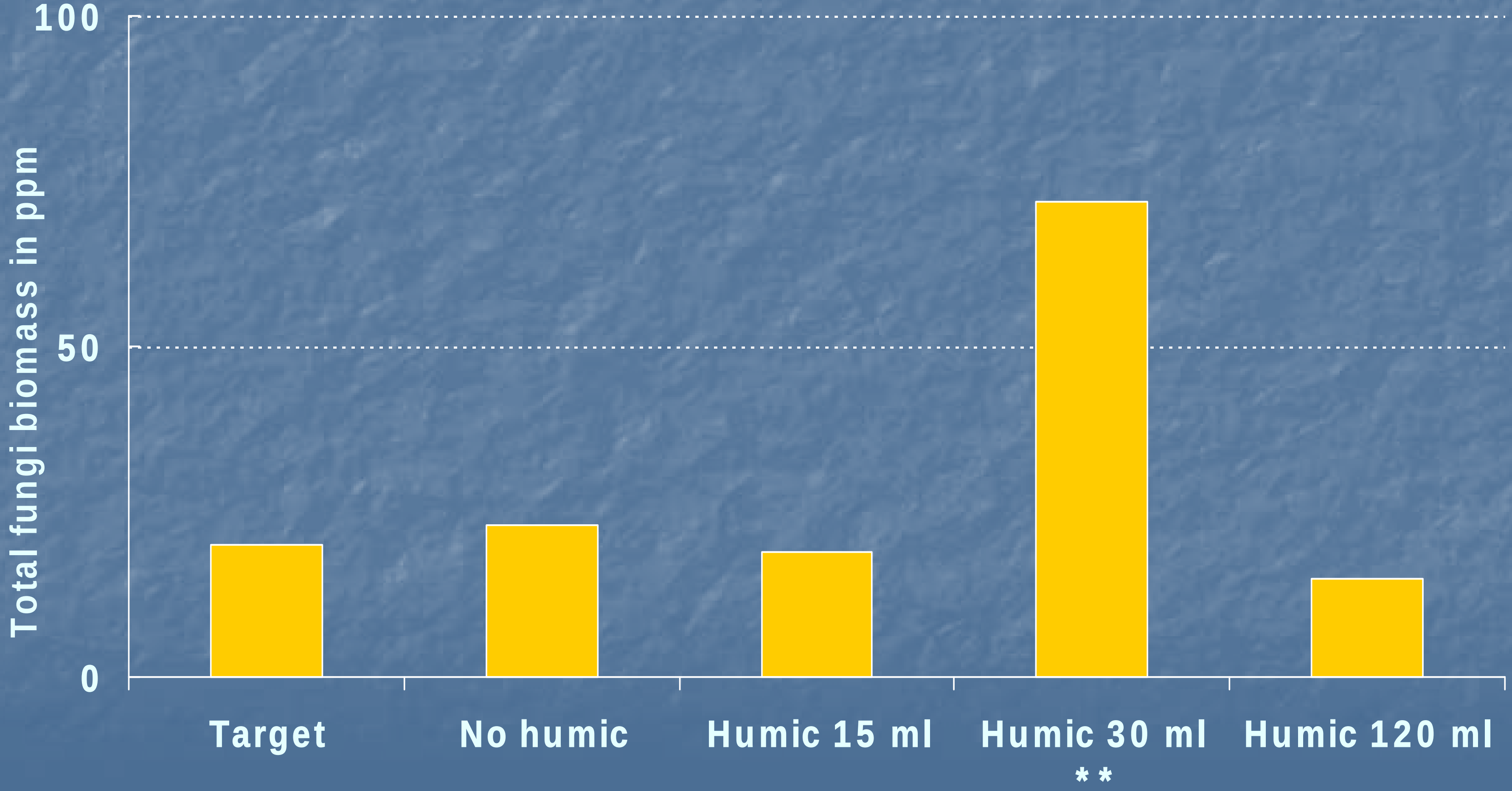

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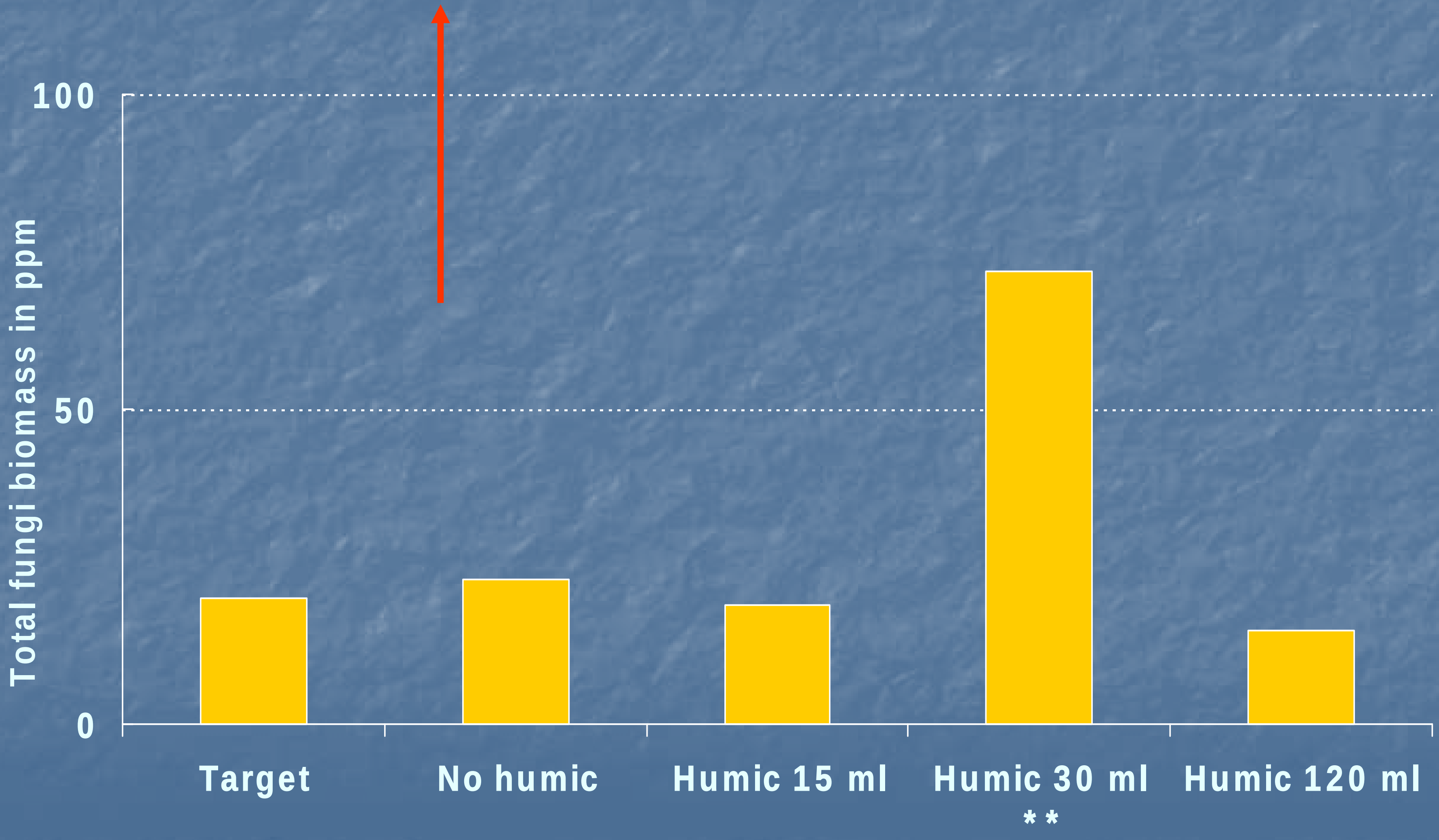


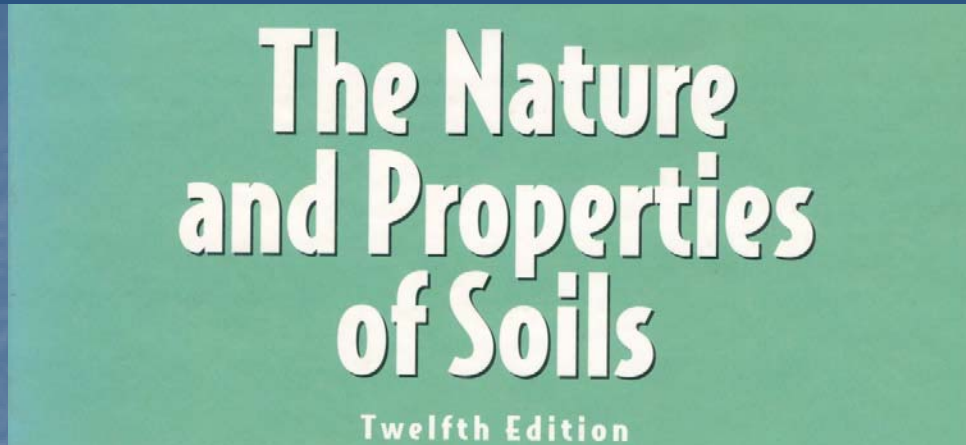
# Question

What is the role of fungi in the soil ?

Can you describe one type of soil fungi ?

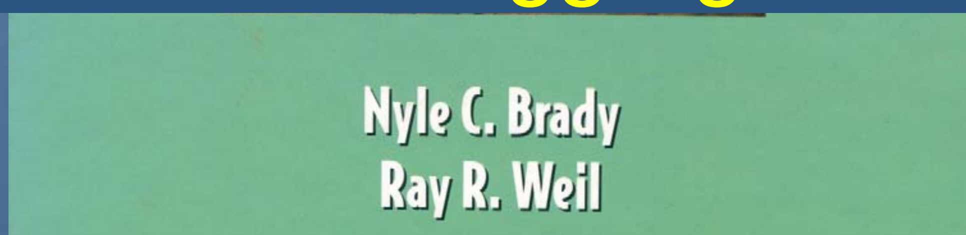
When would we want a “fungal tea” ?

# What is the role of fungi in the soil ?




"Fungal mycelia are visible as white strands...
Fungi depend on organic materials...
They dominate biomass and activity in soils..."

"Fungi play major roles in the processes of humus formation and aggregate stabilization."



# Formation and maintenance of soil aggregates

## One of the most important and most difficult task in soil management

# Humic acid in compost tea

Impact on total bacteria and fungi, results from Soil FoodWeb Canada, Jan 2006

Tecologic Multi-dynamic Humic extract in Bob’s Brewer 5 gallon

| Treatment | Bacteria (total, ppm) | Fungi (total, ppm) |
| --- | --- | --- |
| Standard tea recipe | | |
| Humic acid only | | |

# Humic acid in compost tea

Impact on total bacteria and fungi, results from Soil FoodWeb Canada, Jan 2006
Tecologic Multi-dynamic Humic extract in Bob's Brewer 5 gallon

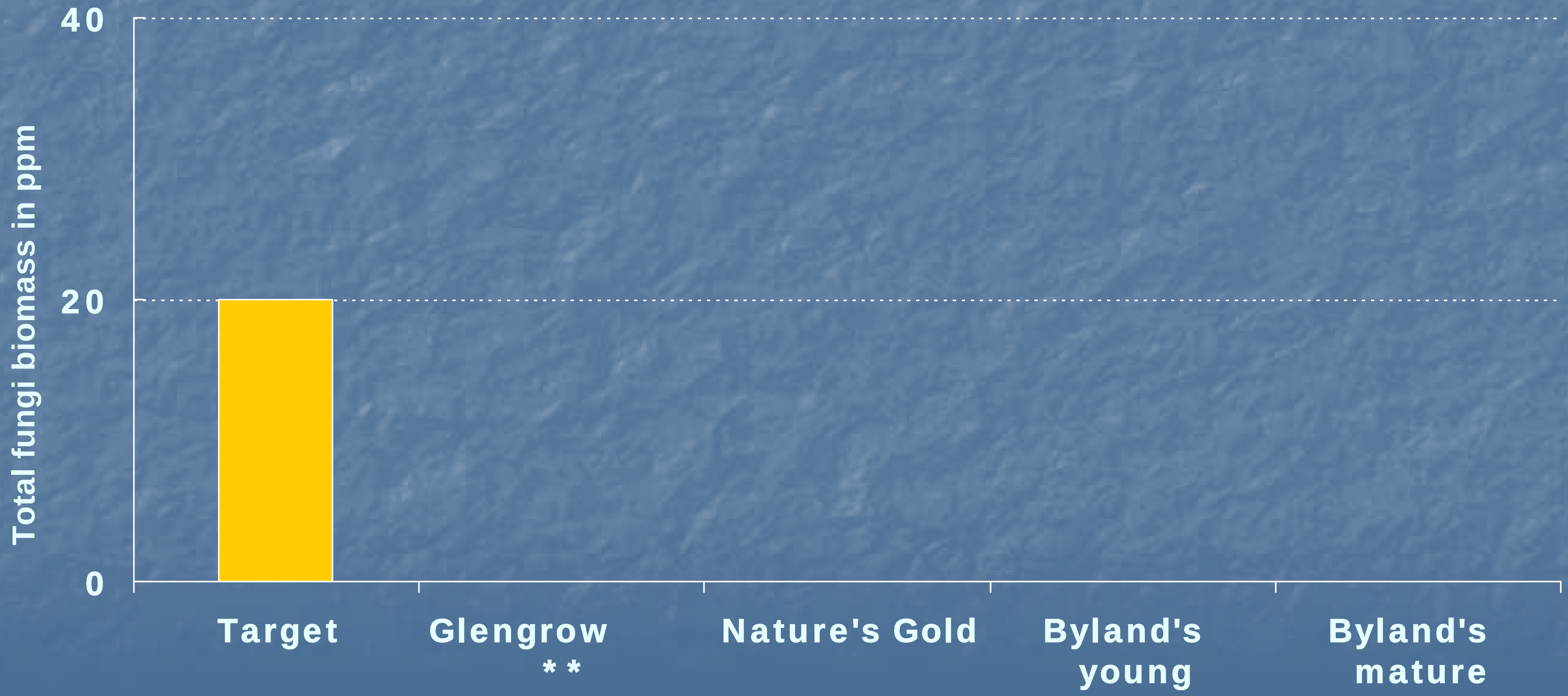
| Treatment | Bacteria (total, ppm) | Fungi (total, ppm) |
|---|---|---|
| Standard tea recipe | 8448 | 25 |
| Humic acid only | 25 | 0 |

# If fungi do not come from humic acid, where do they come from ?

| Treatment | Bacteria (total, ppm) | Fungi (total, ppm) |
|---|---|---|
| Standard tea recipe | 8448 | 25 |
| Humic acid only | 25 | 0 |

# Different composts to prepare tea

Impact on total fungi, results from Soil FoodWeb Canada, March 2006
Glengrow and Byland's are yard waste; Nature's Gold is sewage sludge



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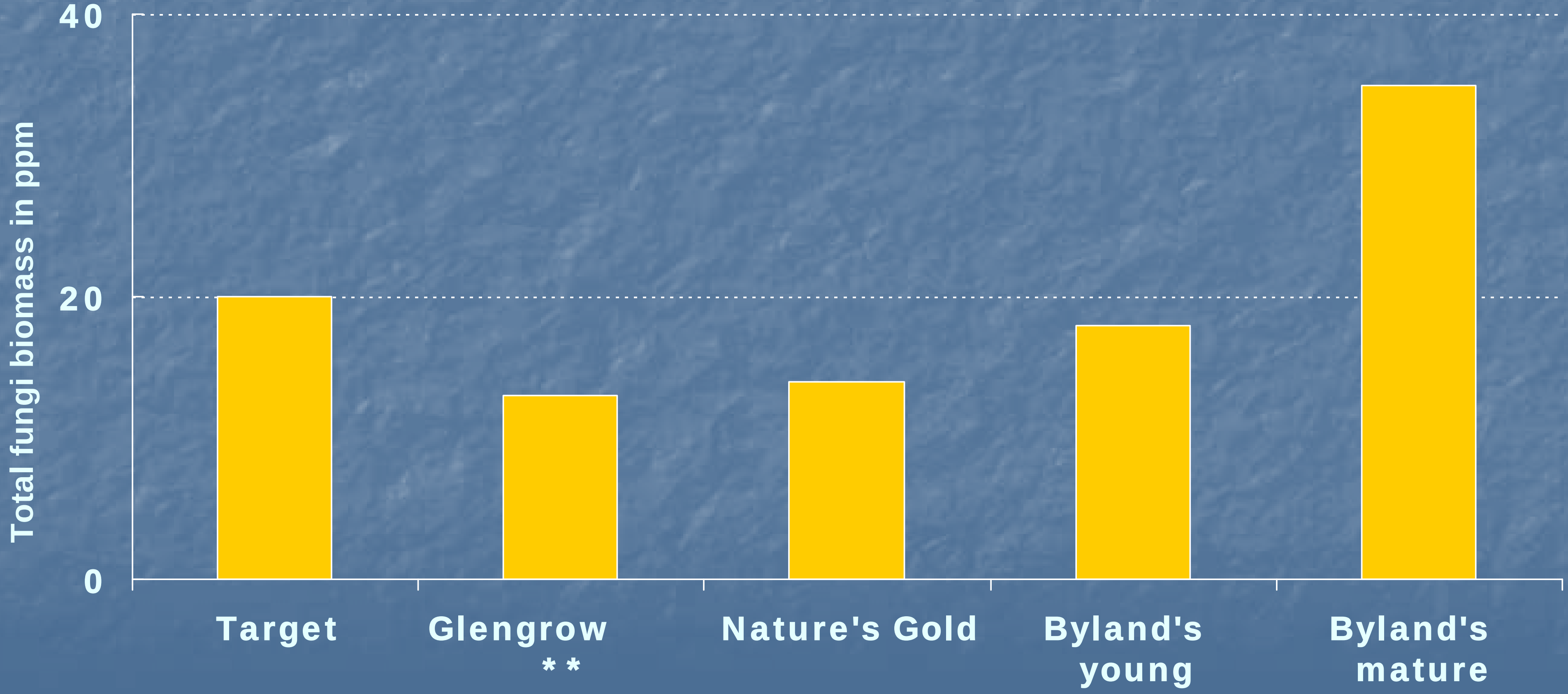


# Vermicompost, one ingredient in compost tea

# Vermicompost to prepare tea

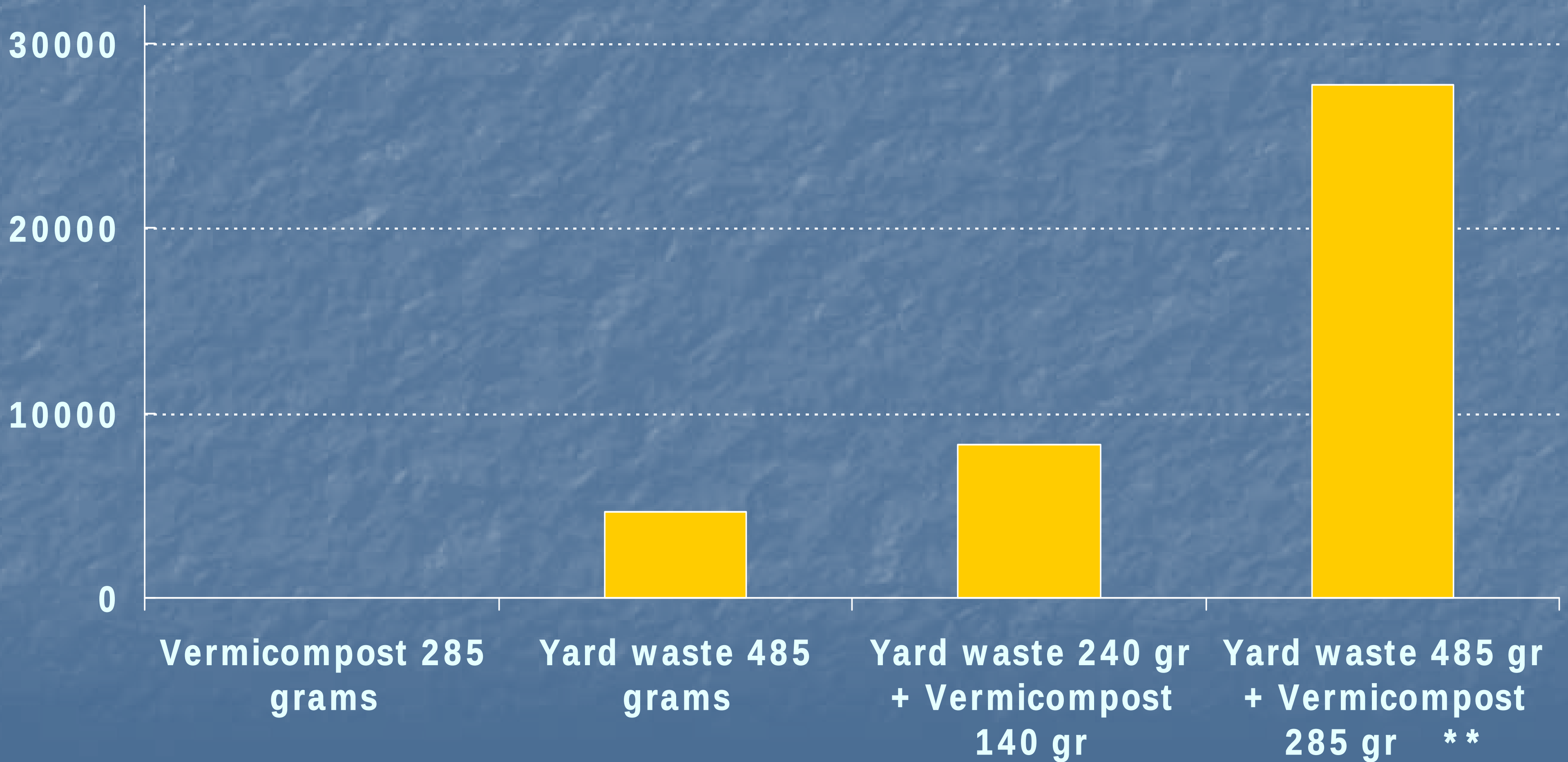
Impact on flagellates, results from Soil FoodWeb Canada, Feb 2006

Vermicompost: Nurturing Nature Organics.  Composted yard waste: Glengrow

# Vermicompost to prepare tea

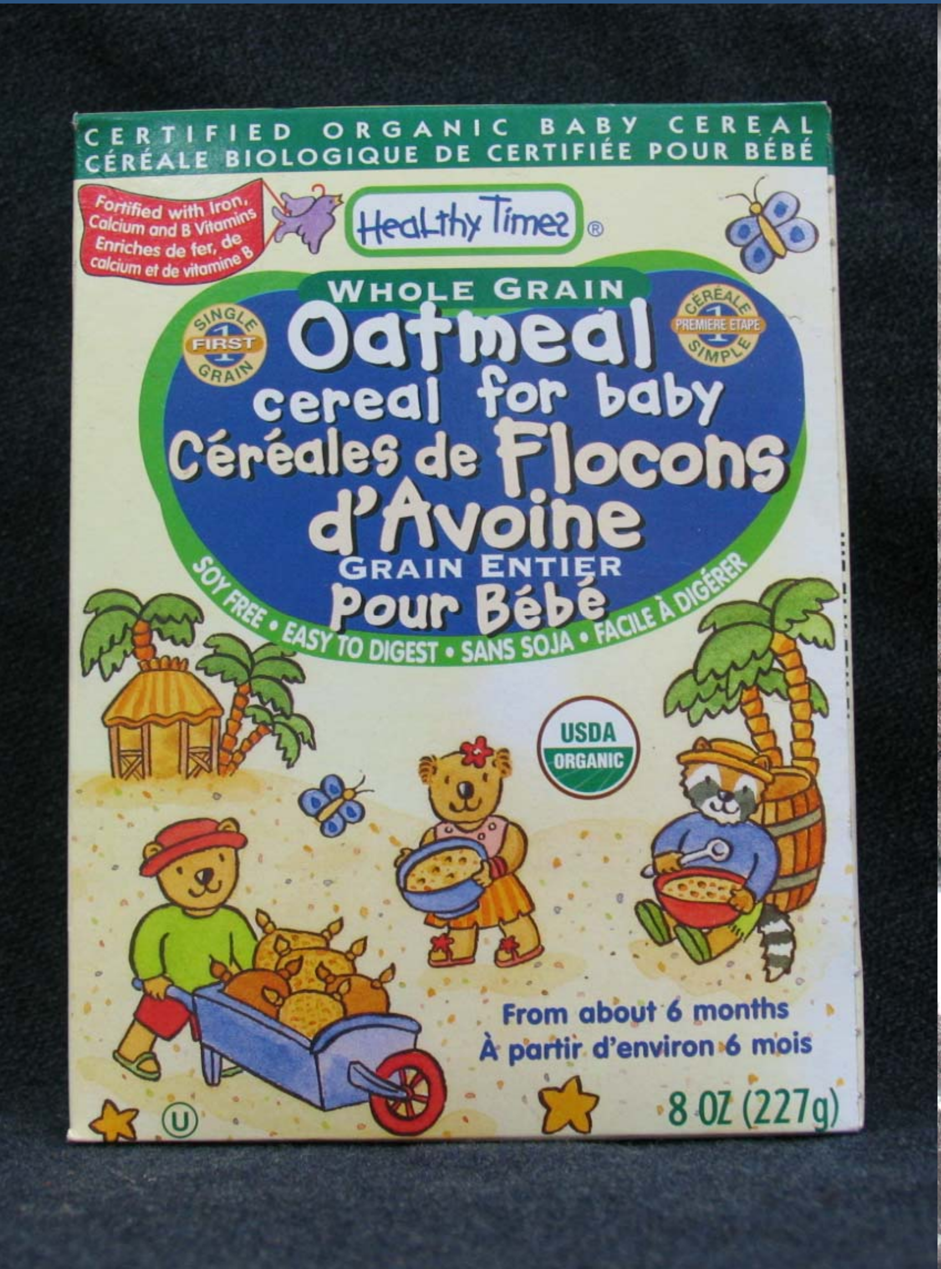
Impact on flagellates, results from Soil FoodWeb Canada, Feb 2006

Vermicompost: Nurturing Nature Organics.  Composted yard waste: Glengrow



# White filaments in compost – Strands of fungi

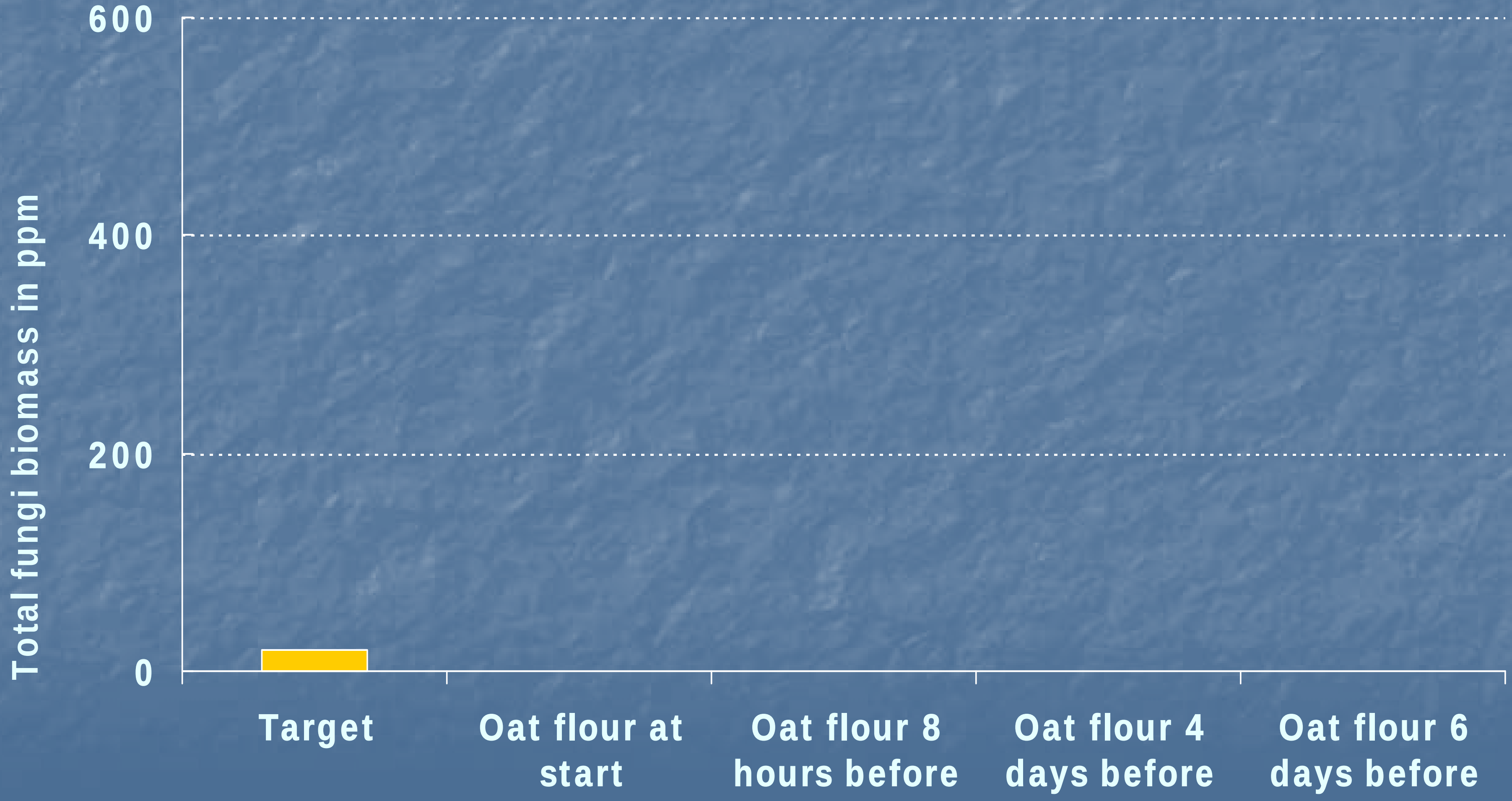
# "Activate" fungal growth with protein food




# Activation of compost

Impact on fungi, results from Soil FoodWeb Canada, Feb 2006

Oat flour mixed at 12% concentration (90 grams), Bob's Brewer 5 gallon



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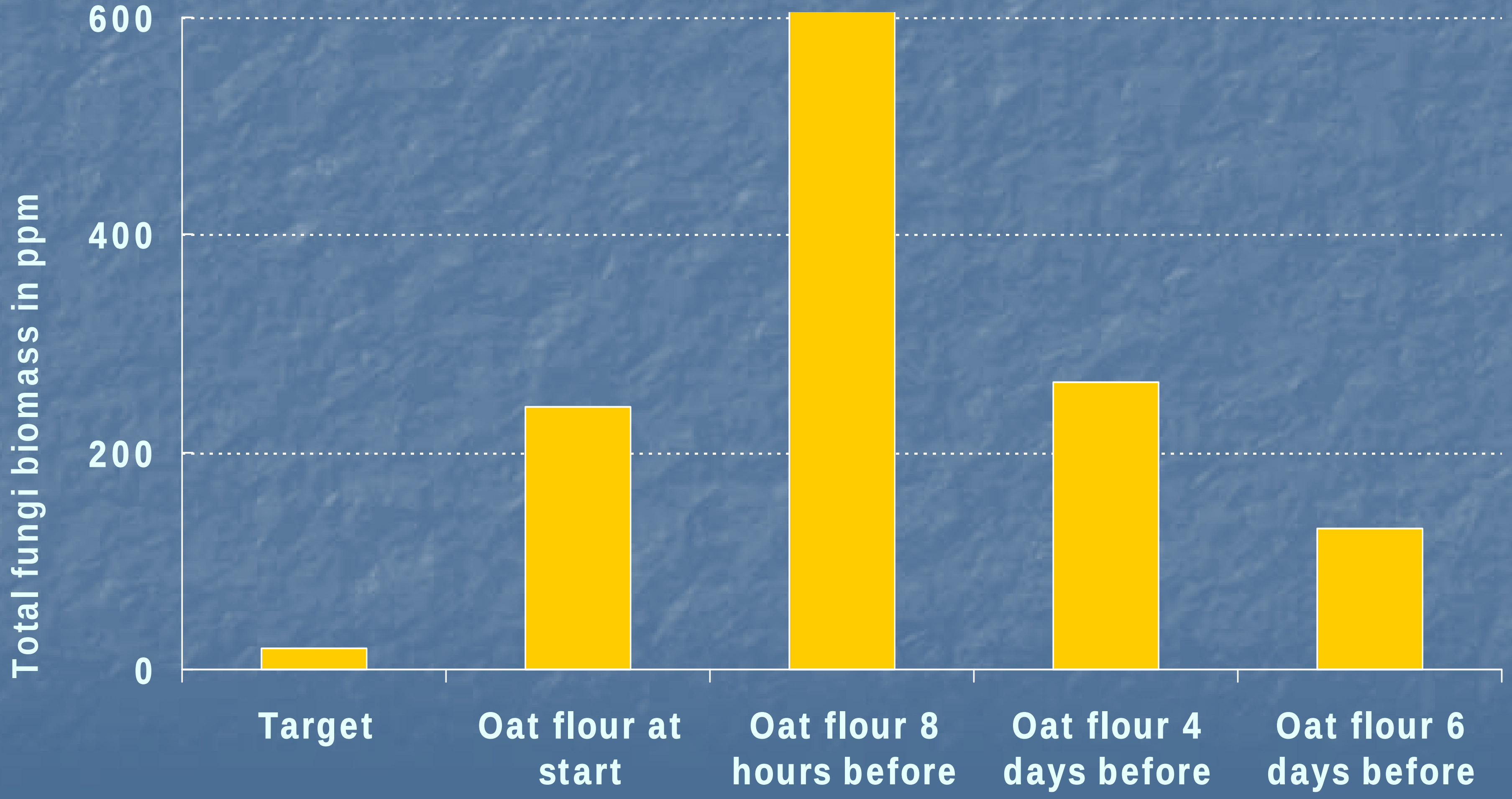
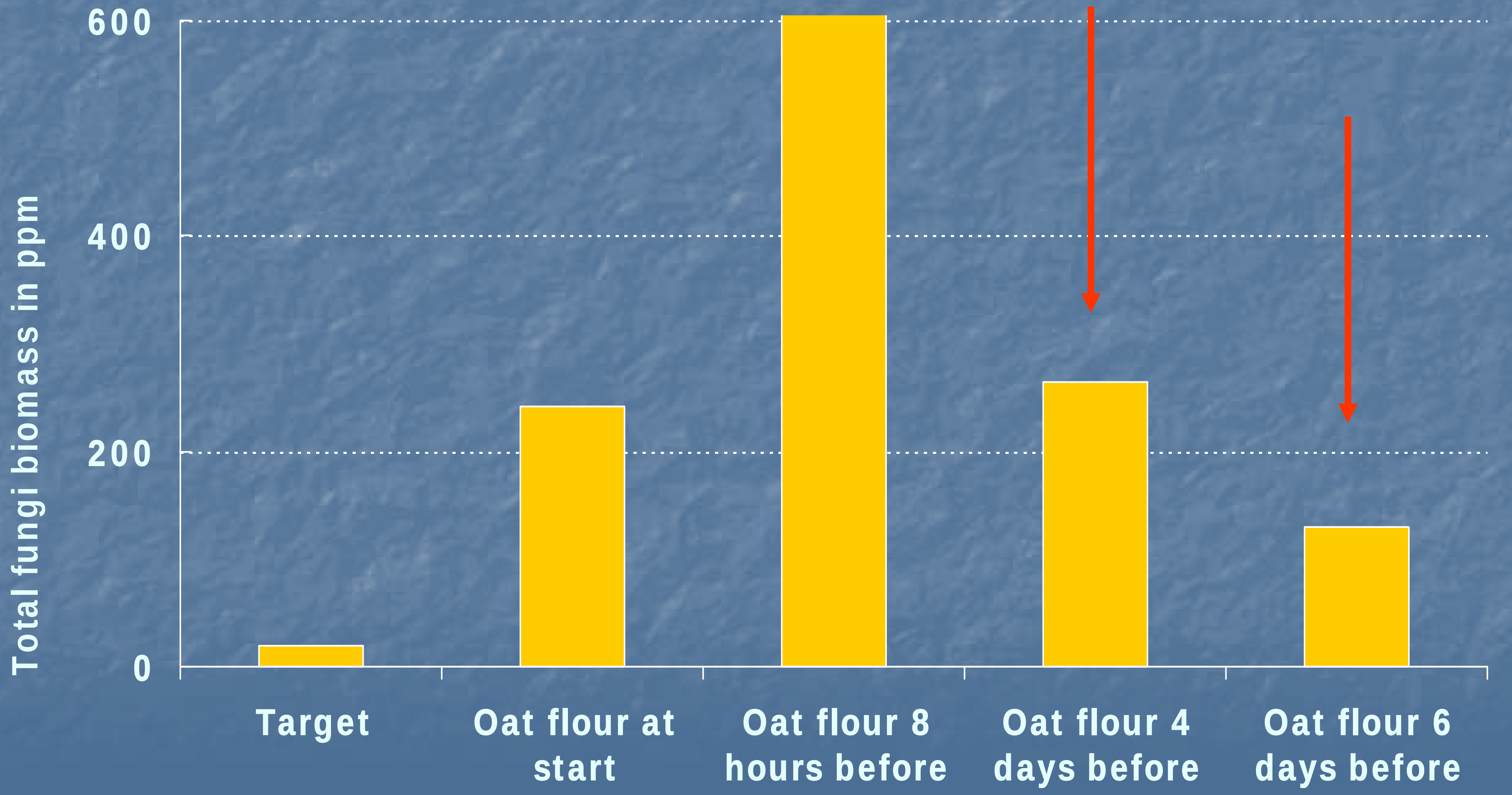
Oat flour mixed at 12% concentration (90 grams), Bob's Brewer 5 gallon

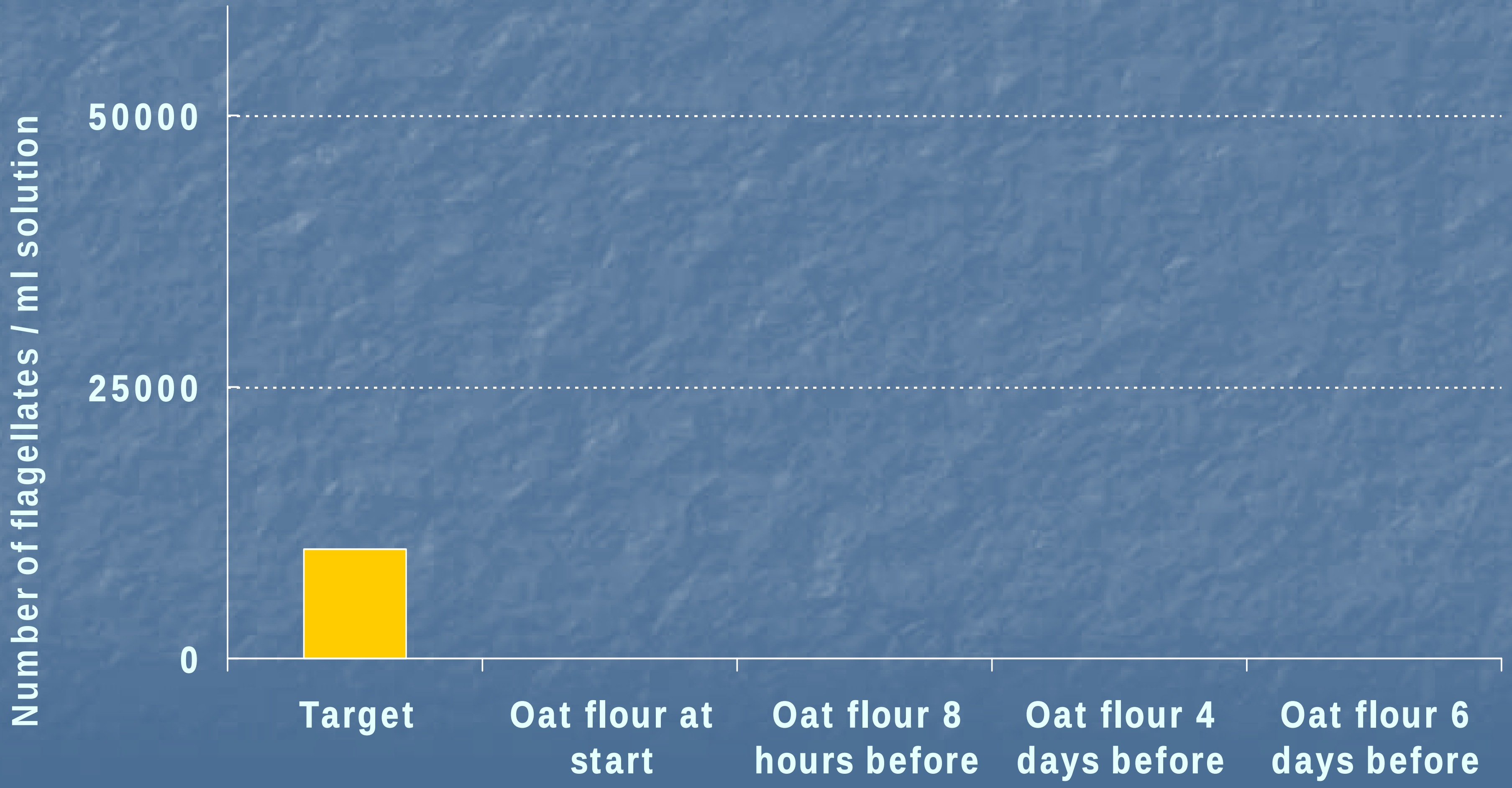


# What happened to the fungi at 4 days and 6 days ?



# Same test - Activation of compost

Impact on flagellates, results from Soil FoodWeb Canada, Feb 2006
Oat flour mixed at 12% concentration (90 grams), Bob's Brewer 5 gallon



# Same test - Activation of compost

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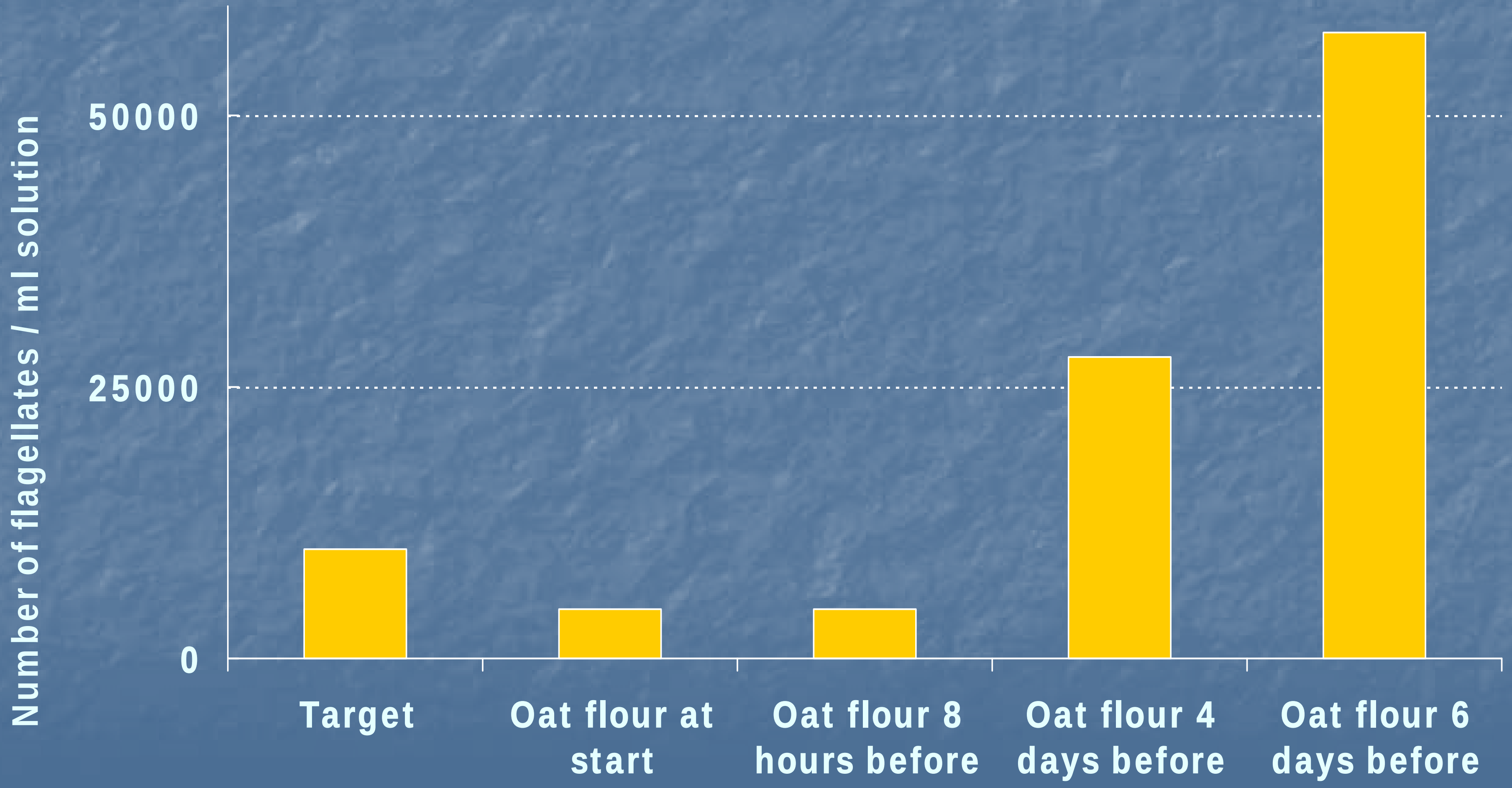


# Question

Flagellates are one type of protozoa.

What is the role of protozoa in the soil ?

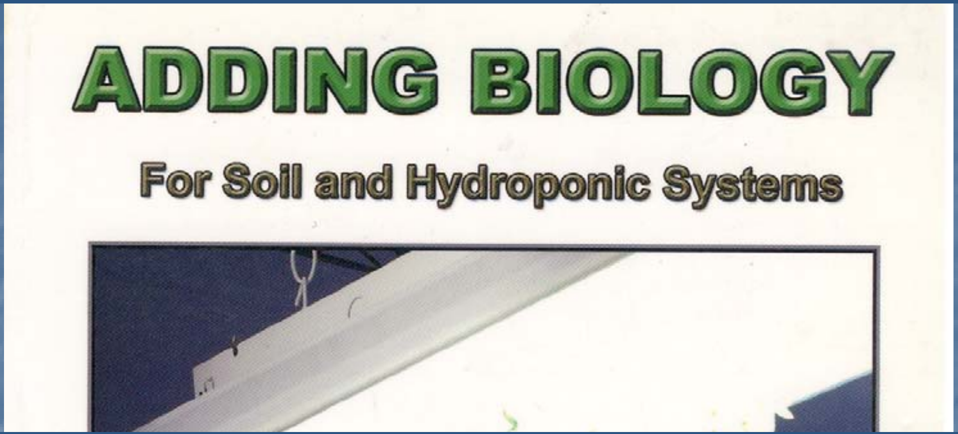
Can you describe one type of soil protozoa ?

When would we want a “protozoal tea” ?


Dr. Elaine Ingham

Written for growers 2006

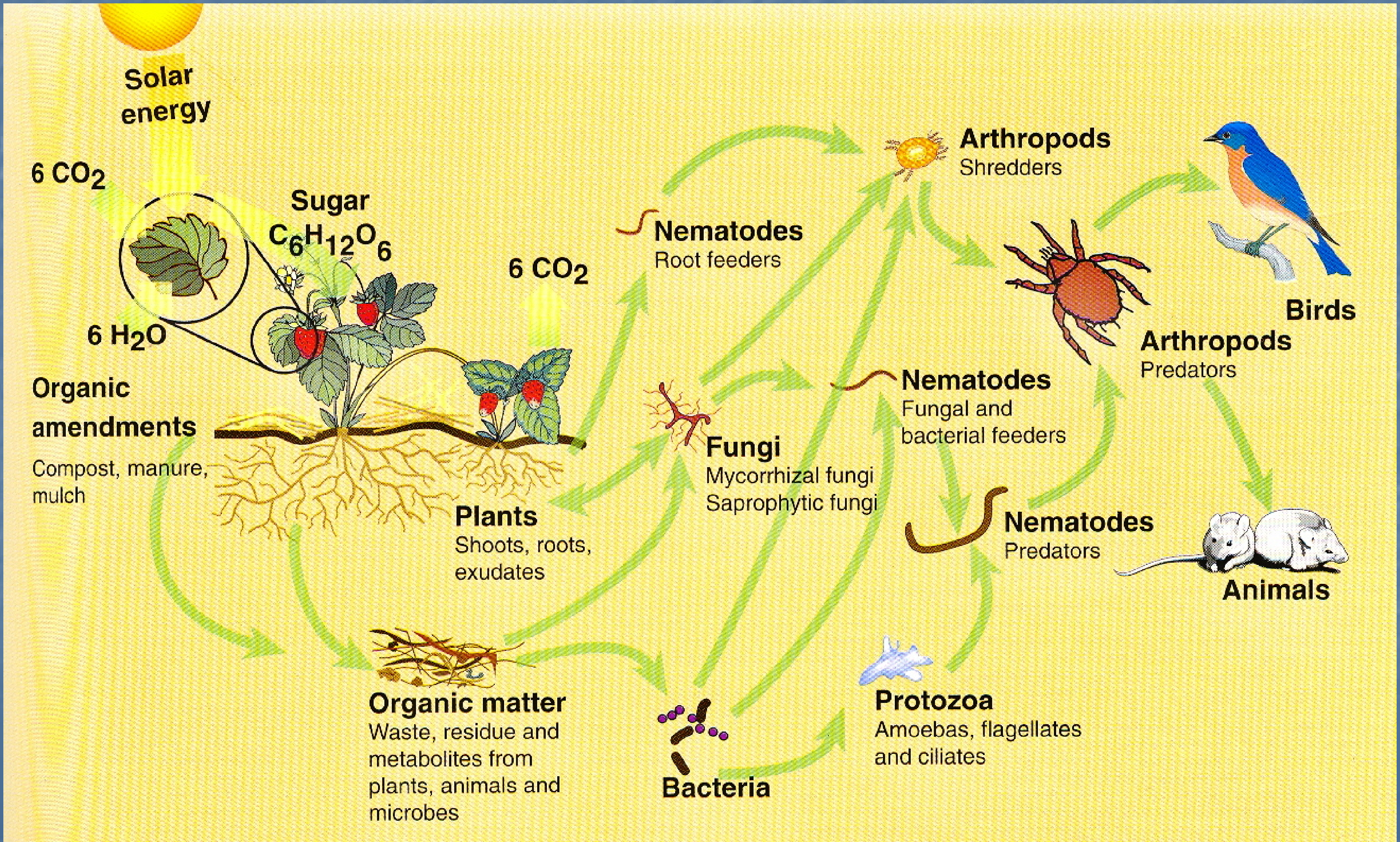
# What is the role of protozoa in the soil ?




"Protozoa make nutrients available to plants...
Protozoa eat bacteria and release nitrogen…
They are flagellates, amoebae and ciliates..."

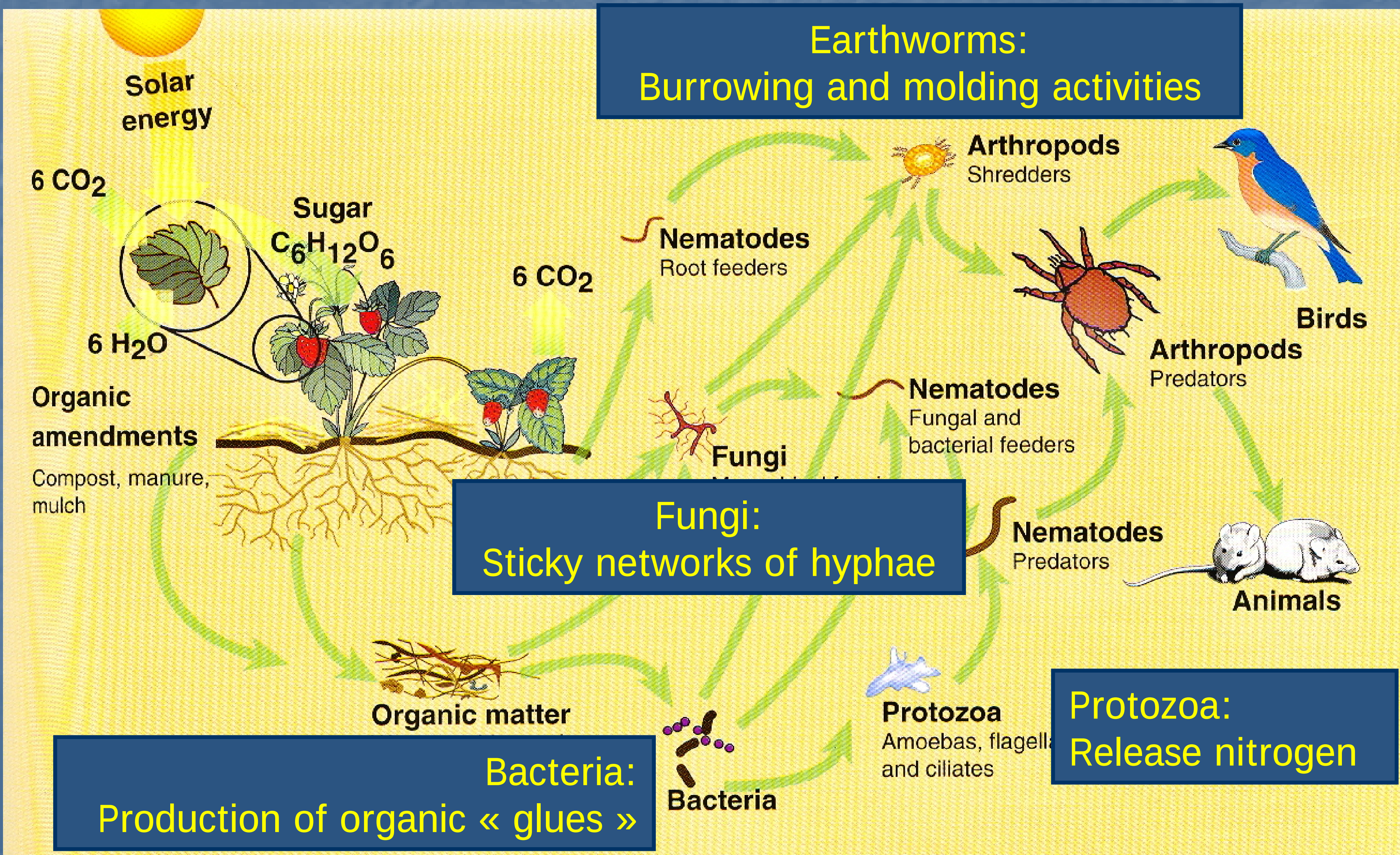
# Components of soil foodweb

«Fruit crop ecology and management», Michigan State University, 2002



# Components of soil foodweb

«Fruit crop ecology and management», Michigan State University, 2002




Earthworms:
Burrowing and molding activities

Fungi:
Sticky networks of hyphae

Bacteria:
Production of organic « glues »

Protozoa:
Release nitrogen

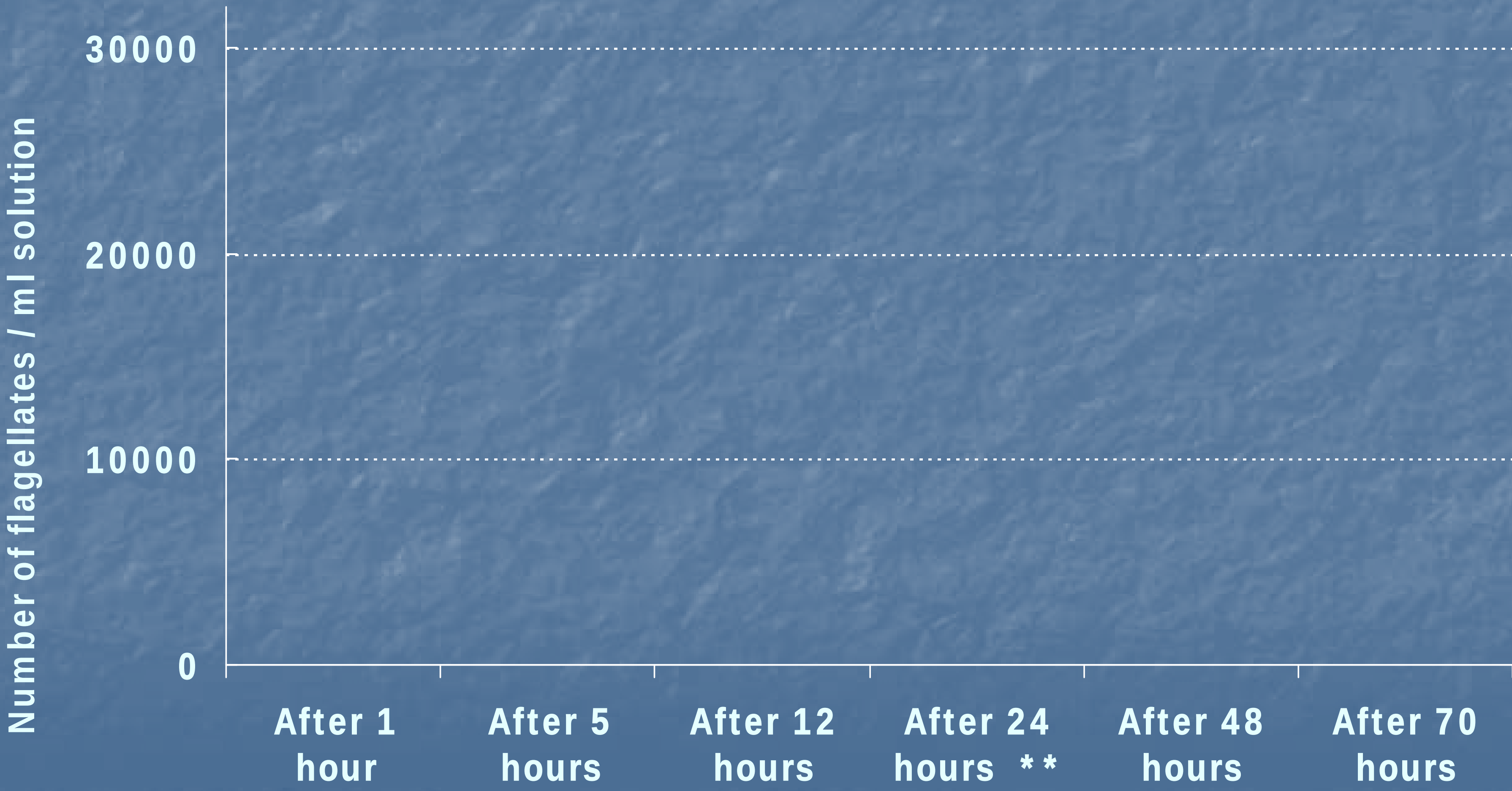
# Back to the comparative brewing in our lab...

# Why do we aerate for so many hours ?

# Aeration time in brewing

Impact on flagellates, results from Soil FoodWeb Canada, Feb 2006

Standard recipe, samples collected at intervals, stored in a refrigerator



# Aeration time in brewing

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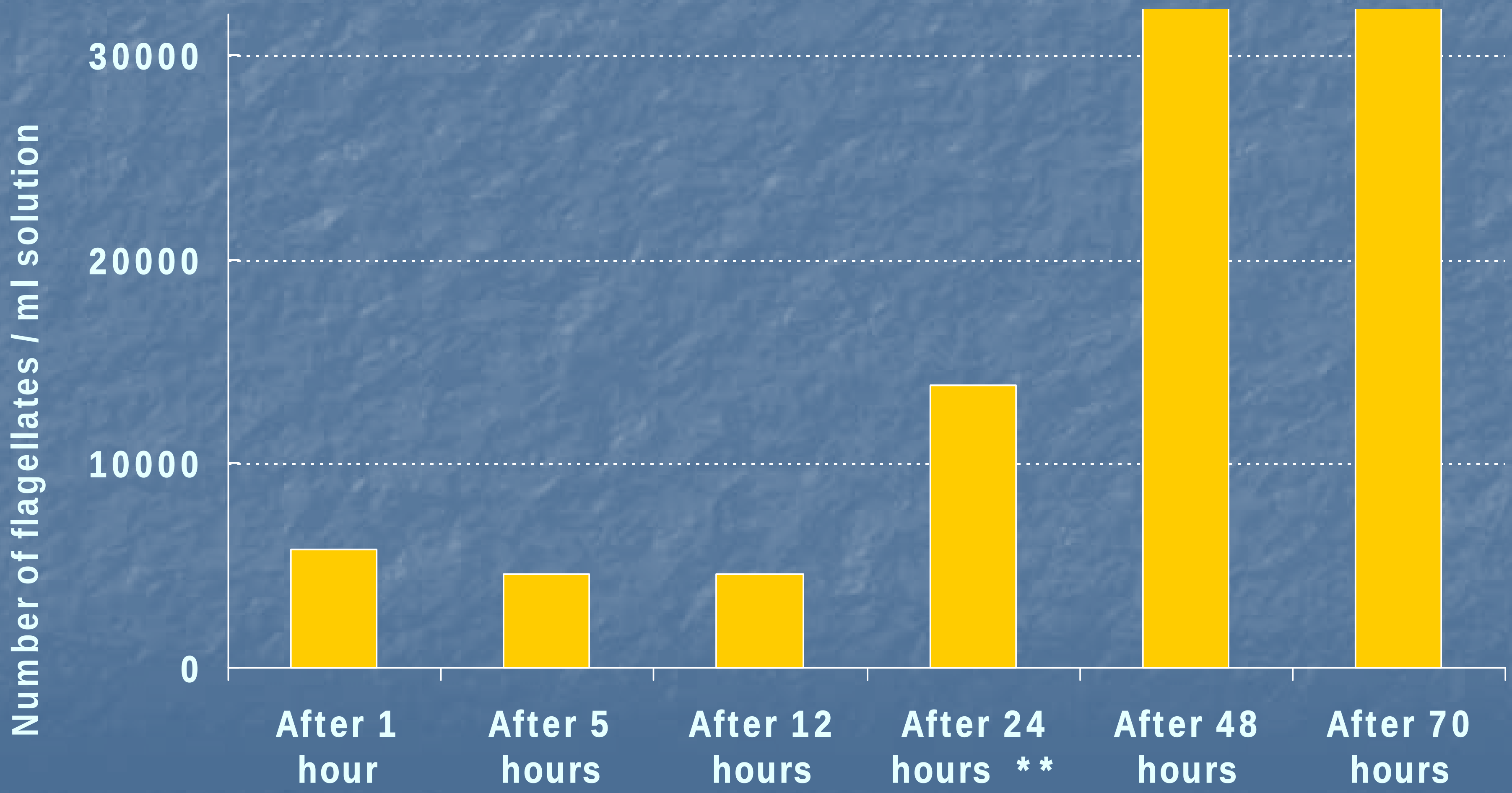

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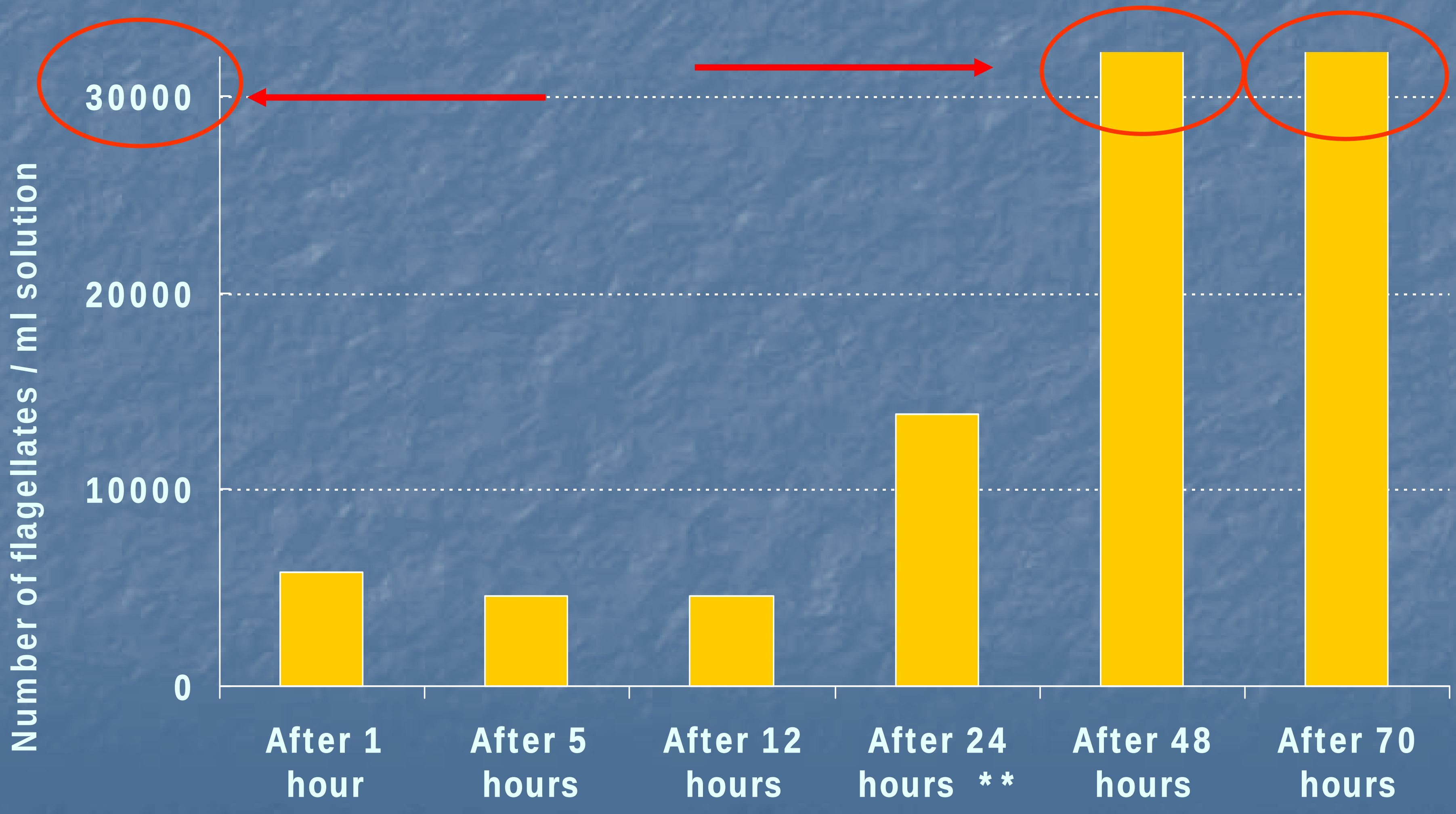
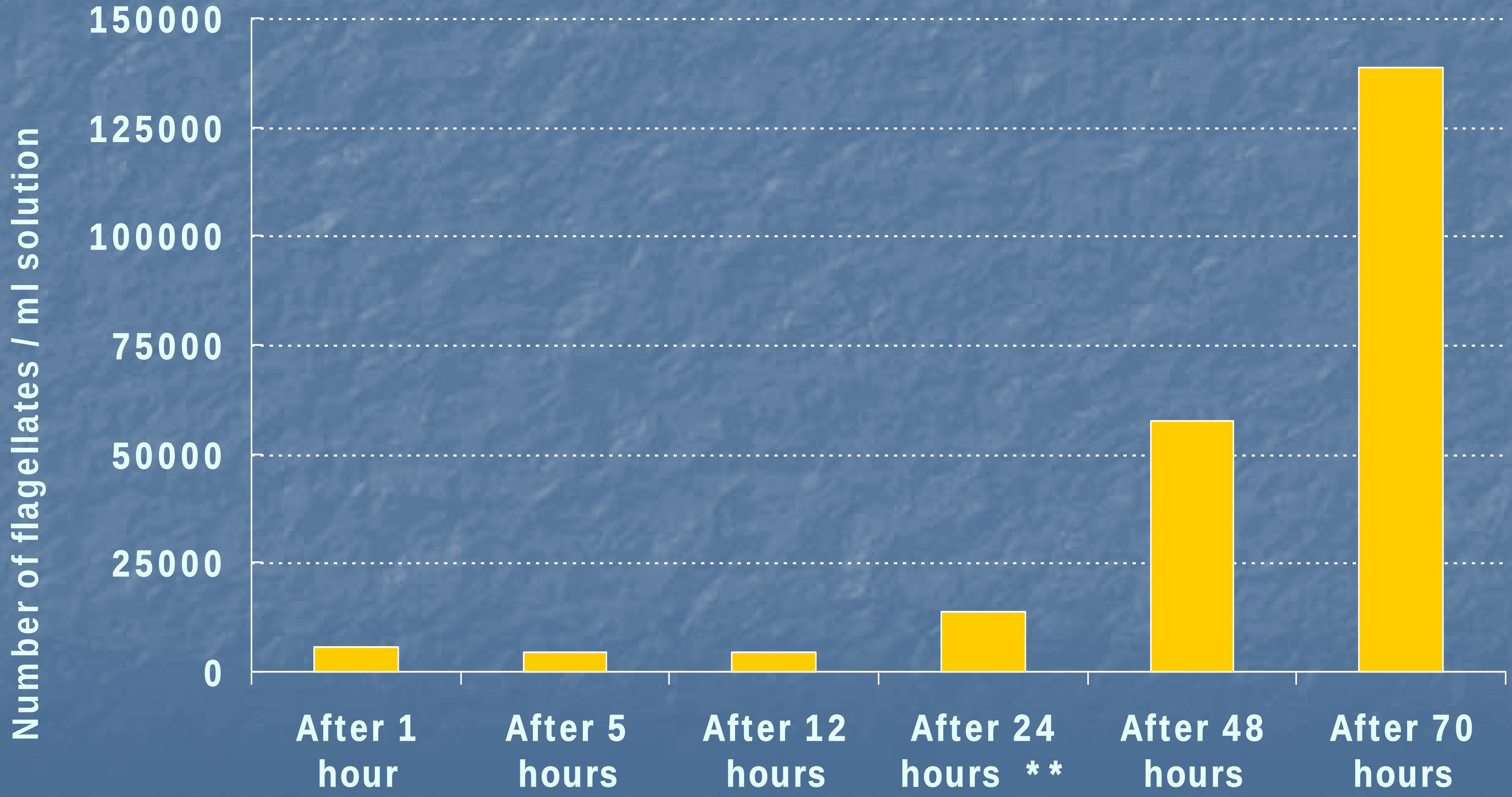


# Aeration time in brewing

Impact on flagellates, results from Soil FoodWeb Canada, Feb 2006
Standard recipe, samples collected at intervals, stored in a refrigerator



# Build-your-own compost tea brewer

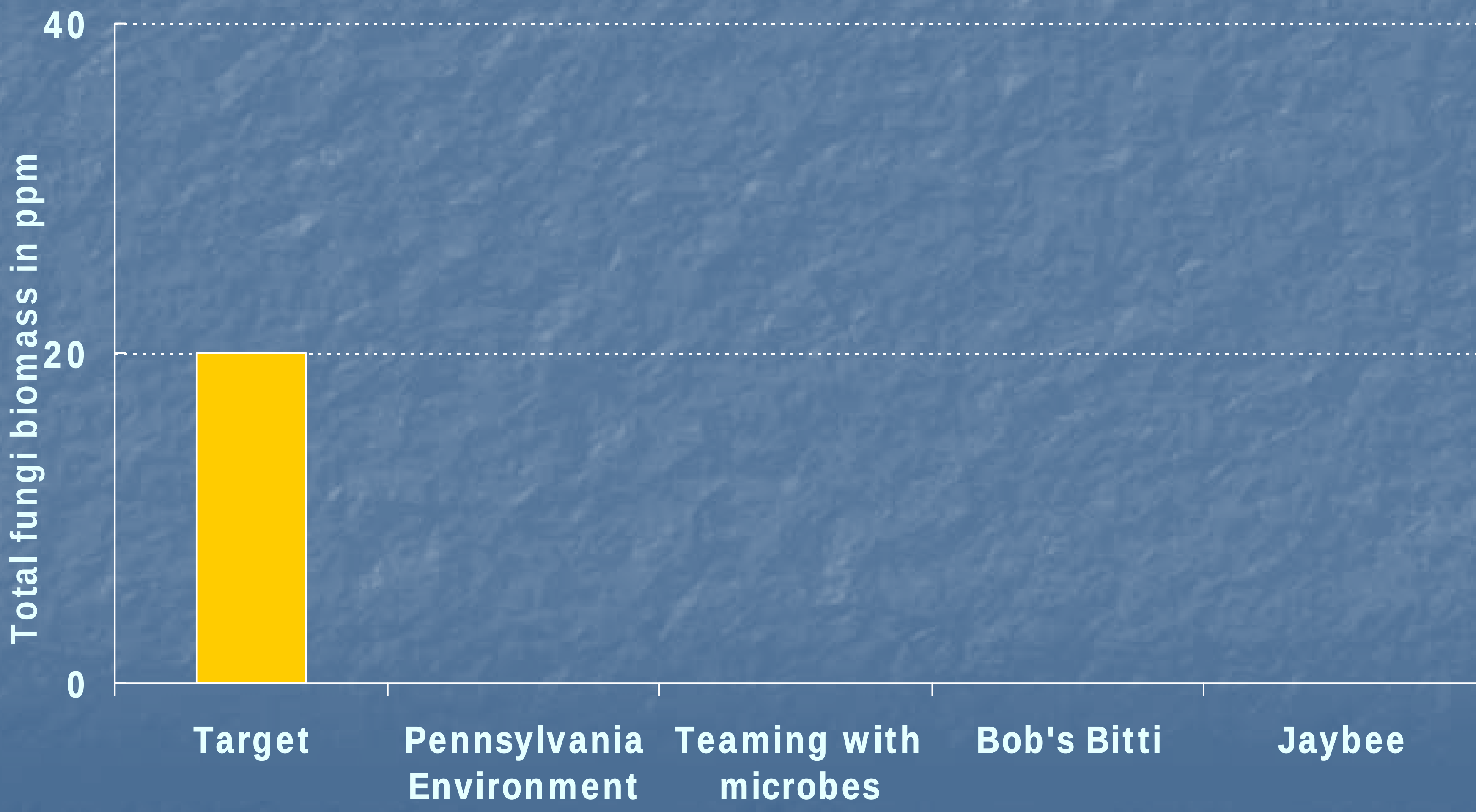
Left: Pennsylvania Dept Environment    Right: “Teaming with microbes”

# Testing home-made vs commercial brewers

# Home-made vs Commercial brewers

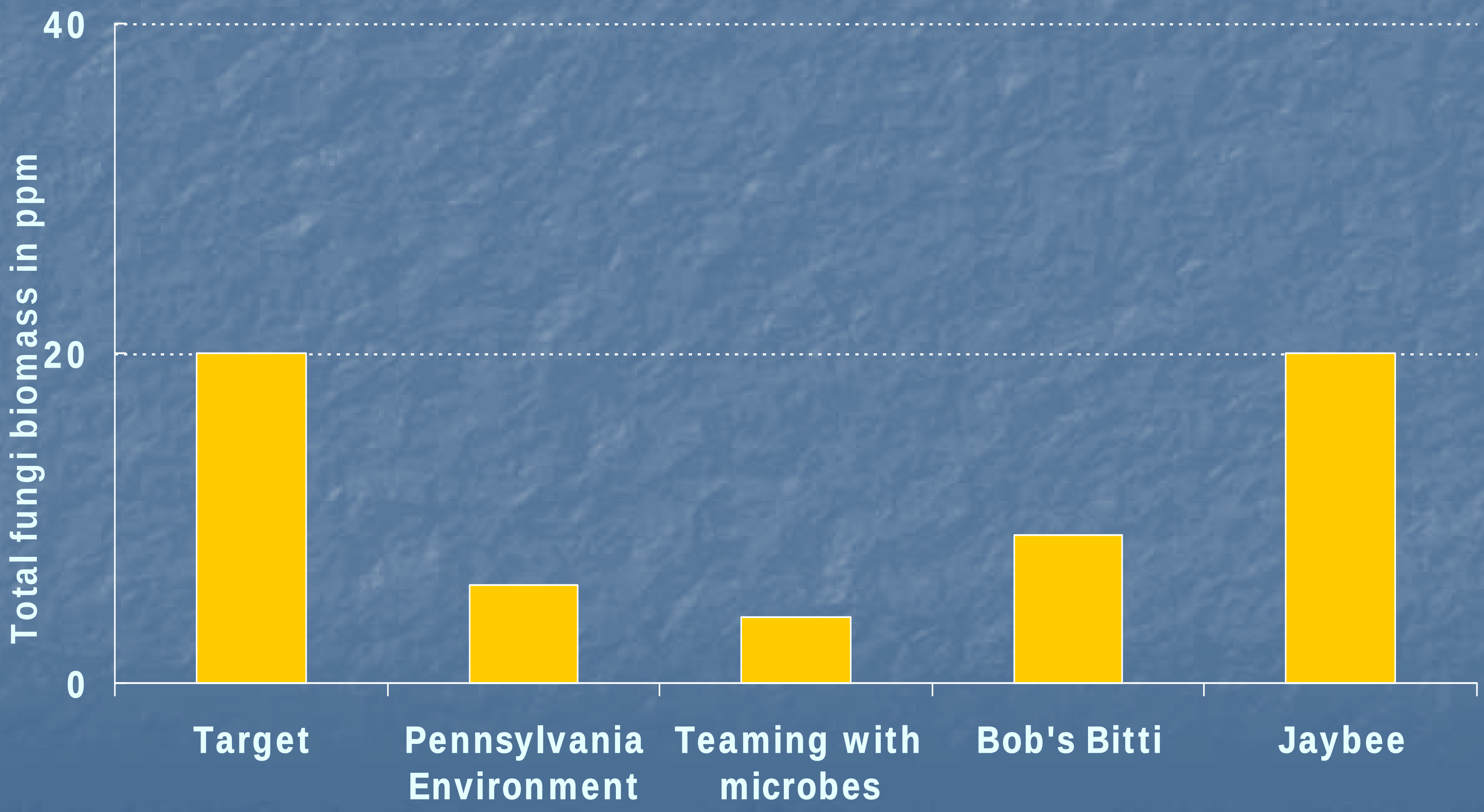
Impact on total fungi, results from Soil FoodWeb Canada, March 2008

Home made: Pennsylvania and Teaming. Commercial: Bob’s and Jaybee



# Home made vs Commercial brewers

Impact on total fungi, results from Soil FoodWeb Canada, March 2008
Home made: Pennsylvania and Teaming.  Commercial: Bob’s and Jaybee



# Compost tea recipe
## Our best attempt

- Water

  15 to 20 liters, any source, aerate to remove chlorine

- Compost

  1 liter (500 grams) + Worm castings 0.5 L (285 grams)

- Other ingredients

  Humic extract 30 ml
  Kelp (cold-water source) 30 ml
  Fish fertilizer 15 ml

- Brew for 5 hours, then remove ingredients

  Continue brewing another 15 hours

# Trial in organic apple orchards in 2004

Comparing soil application of compost or compost tea or tea over compost

# Compost tea: impact on soil biology

Trial at W.S. Mennell, Cawston.  Results from Soil FoodWeb Oregon, 2004

| Treatment | Bacteria (biomass in ppm) | Fungi (biomass in ppm) | Flagellate (biomass in ppm) |
|---|---|---|---|
| *Target* | *150 - 300* | *150 - 300* | *> 10,000* |
| Untreated | | | |
| Manure | | | |
| Tea 3 apps | | | |
| Manure + Tea | | | |

# Compost tea: impact on soil biology

Trial at W.S. Mennell, Cawston. Results from Soil FoodWeb Oregon, 2004

| Treatment | Bacteria (biomass in ppm) | Fungi (biomass in ppm) | Flagellate (biomass in ppm) |
|---|---|---|---|
| *Target* | *150 - 300* | *150 - 300* | *> 10,000* |
| Untreated | 1,143 | 199 | 3,336 |
| Manure | 3,592 | 198 | 7,065 |
| Tea 3 apps | 2,902 | 326 | 1,679 |
| Manure + Tea | 1,150 | 1,196 | 3,385 |

# Compost tea
# and its impact on Soil biology

| | |
|---|---|
| 8:30 to 9:45 | Hands-on: Preparing compost tea |
| 10:00 to 11:30 | Soil biology<br>“Recipes” for making tea |
| 11:30 to 12:00 | “Recipes” for using tea |

Compost tea

Any question ?

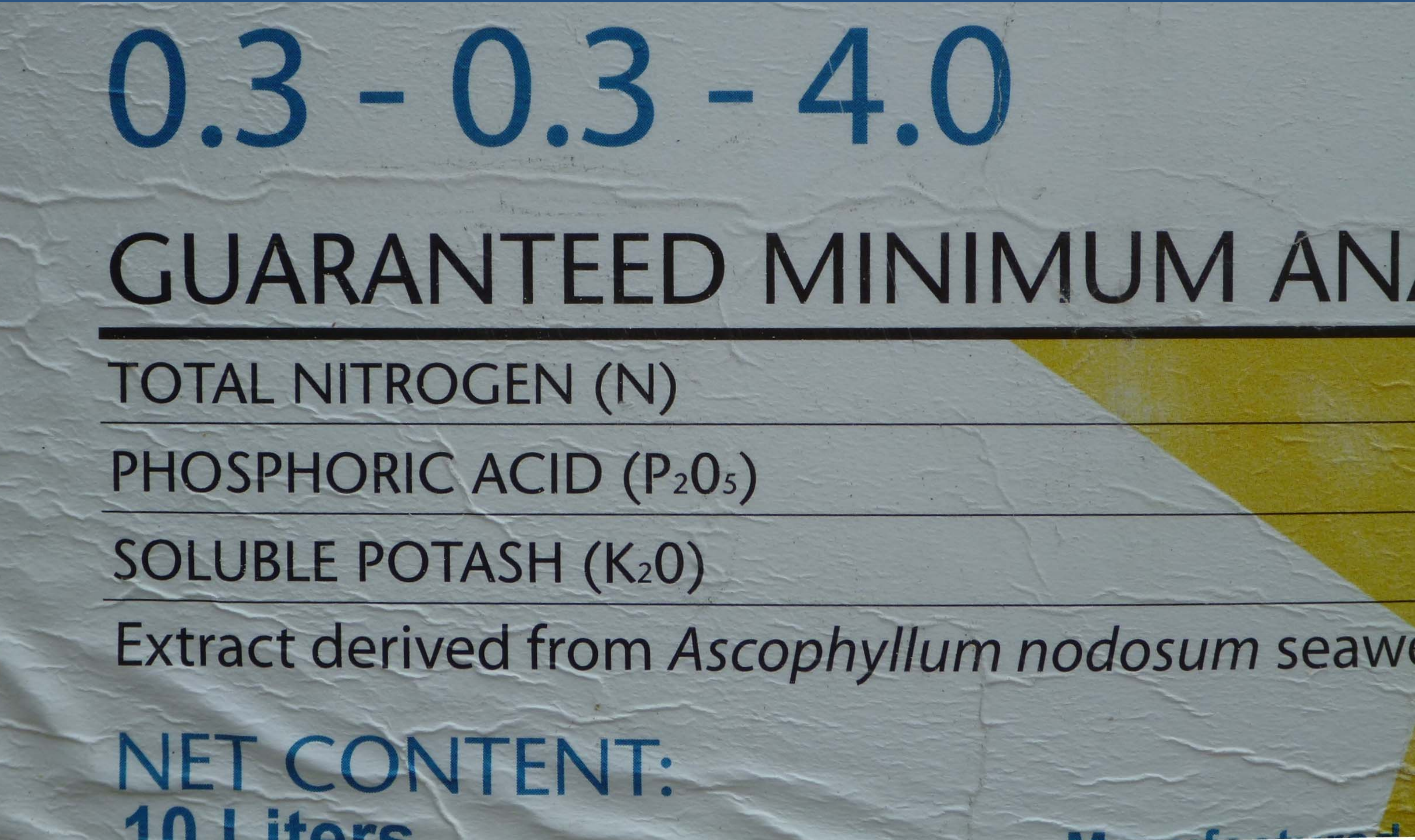
# Compost tea experiments

## Testing at Soil FoodWeb Inc., Vulcan Alberta, 2006

| Date | Lab report | Variation in recipe |
|---|---|---|
| Jan 16 | 08-00160 | Varying amounts of humic acid |
| Jan 23 | 08-00161 | Varying amounts of seaweed |
| Feb 06 | 08-00163 | Varying amounts of fish fertiliser |
| Feb 13 | 08-00166 | Ingredients but no compost |
| Feb 27 | 08-00170 | Compost with one ingredient only |
| Mar 06 | 08-00171 | Compost alone or vermicompost alone |
| Mar 20 | 08-00174 | Varying duration of water aeration |
| Mar 27 | 08-00179 | Using different composts |
| Apr 3 | 08-00182 | Varying duration of compost activation |
| Apr 7 | 08-00190 | Varying length of brewing |
| May 29 | 08-00252 | Varying amounts of RootShield |

# Kelp or Seaweed, one ingredient in compost tea

# *Ascophyllus nodosum* has the best qualities



"It is well documented that commercial seaweed preparations improve plant growth. Many of these effects have been attributed to the presence of growth substances, particularly the cytokinins ..."

Crouch et al. 1992. J Plant Physiology

# Identification of Auxins in a Commercial Seaweed Concentrate

I. J. Crouch[1], M. T. Smith[1], J. van Staden[1], M. J. Lewis[2], and G. V. Hoad[2]

[1] UN/FRD Research Unit for Plant Growth and Development, Department of Botany, University of Natal, P.O. Box 375, Pietermaritzburg 3200, South Africa

[2] Long Ashton Research Station, Department of Agricultural Science, University of Bristol, Long Ashton, Bristol BS18 9AF, United Kingdom

Received August 21, 1991 · Accepted October 28, 1991

**Summary**

Compounds active in the mung bean rooting bioassay were isolated from the neutral indole fraction of a commercial seaweed concentrate by high performance liquid chromatography. A gas-chromatographic-mass spectrometric analysis of the most active fractions indicated the presence of the following indoles: indole-3-acetic acid; indole-3-carboxylic acid; N,N-dimethyltryptamine; indole-3-aldehyde; and in addition, *iso*-indole,1,3-dione (N-hydroxyethyl phthalimide). This appears to be the first report of an indole amine and a phthalimide in algae. Attempts are currently being made to determine the efficacy of these compounds individually, and in combination, in the mung bean bioassay.

*Key words: Seaweed concentrate; Ecklonia maxima; root formation; indole-3-acetic acid; indole-3-carboxylic acid; N,N-dimethyltryptamine; indole-3-aldehyde; iso-indole,1,3-dione (N-hydroxyethyl phthalimide).*

*Abbreviations:* SWC = seaweed concentrate; IAA = indole-3-acetic acid; ICA = indole-3-carboxylic acid; IAld = indole-3-aldehyde; IAcet = indole-3-acetamide; TRP = tryptophan.

## Introduction

It is well-documented that commercial seaweed preparations improve plant growth (Metting et al., 1991). Many of these effects have been attributed to the presence of growth substances, particularly the cytokinins, which are known to occur at relatively high levels in various seaweeds and commercial seaweed preparations (Pederson, 1973; Blunden and Wildgoose, 1977; Featonby-Smith and Van Staden, 1984a; Tay et al., 1985, 1987). The application of SWC to plants has been reported to significantly increase root initiation and growth (Featonby-Smith and Van Staden, 1984b; Beckett and Van Staden, 1989). Since it is well-established that both endogenous and synthetic auxins stimulate rooting (Jackson and Harney, 1970; Hartmann and Kester, 1975), and cytokinins inhibit rooting (Van Staden and Harty, 1988), the possibility exists that the observed rooting response following seaweed application is due to auxins. Kingman and Moore (1982) detected indole-3-acetic acid in the commercial seaweed extract, ‹Maxicrop›, using GLC techniques, a finding recently confirmed by GC-MS identification (Sanderson et al., 1987).

The commercial seaweed concentrate, ‹Kelpak›, was recently shown to increase rooting in the mung bean bioassay in a concentration-dependent manner, and promoted rooting in cuttings of several ornamentals (Crouch and Van Staden, 1991). This paper reports the isolation and identification of a number of indole derivatives from the commercial preparation of the brown alga *Ecklonia maxima* (Osbeck) Papenfuss.

## Materials and Methods

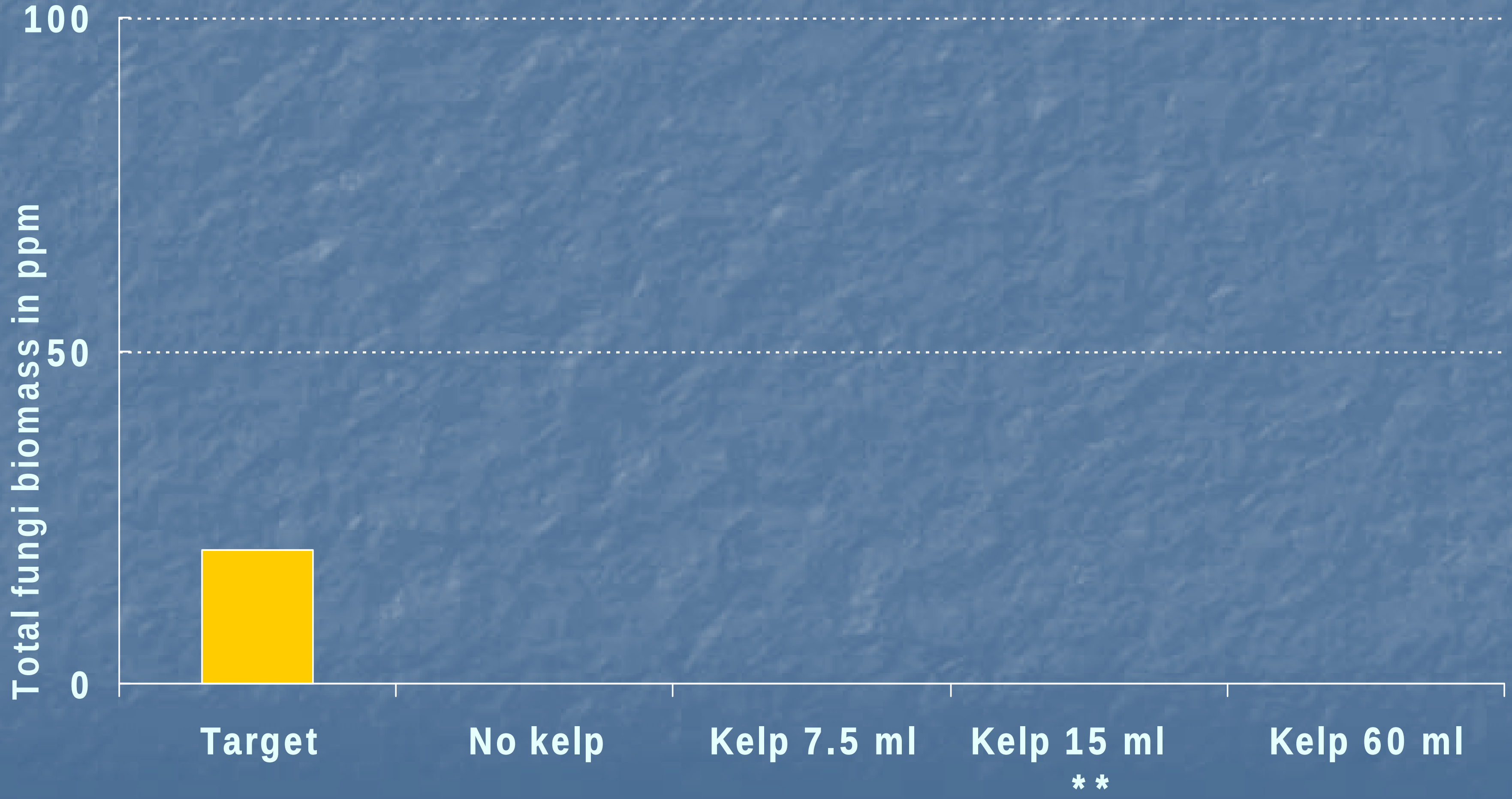
The seaweed concentrate used in this study is marketed as ‹Kelpak› and prepared by a cell-burst process from the brown alga *Ecklonia maxima* (Osbeck) Papenfuss (Featonby-Smith and Van Staden, 1983).

One hundred millilitres of SWC was extracted in 80 % methanol (AR grade) for 12 h at 10 °C. The methanol fraction was separated

# Seaweed in compost tea

Impact on total fungi, results from Soil FoodWeb Canada, Jan 2006

Turbo SE 0-4-4 (*Ascophyllum n.*) in Bob's Brewer 5 gallon



# Seaweed in compost tea

Impact on total fungi, results from Soil FoodWeb Canada, Jan 2006
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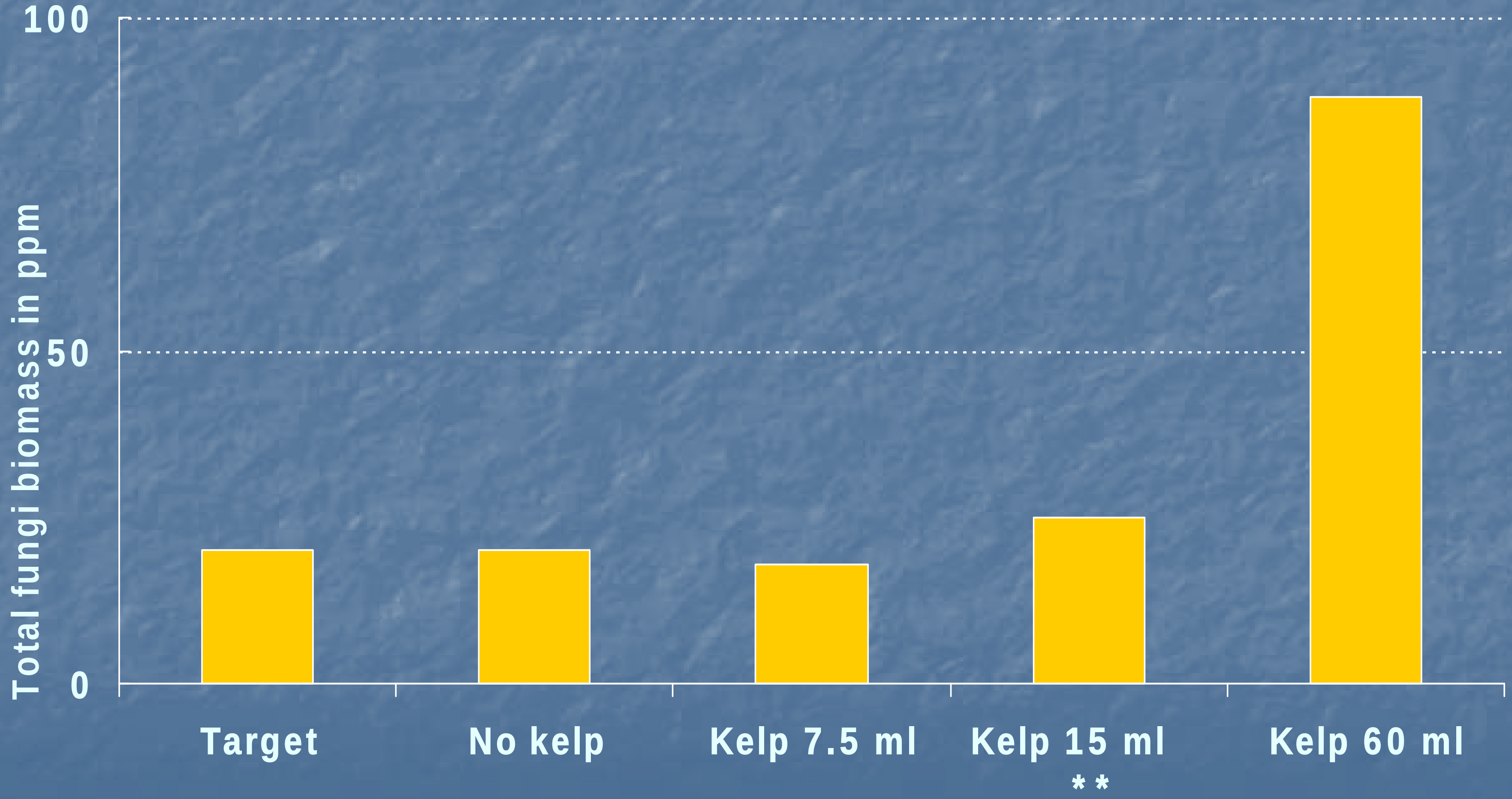


# Fish fertiliser, one ingredient in compost tea

Abbasi, Conn, Lazarovits
2004
Canadian Journal of Plant Pathology

"These results suggest that fish emulsion has both nutritive value for plant growth as well as disease suppressive properties".



# Suppression of *Rhizoctonia* and *Pythium* damping-off of radish and cucumber seedlings by addition of fish emulsion to peat mix or soil

**Pervaiz A. Abbasi, Kenneth L. Conn, and George Lazarovits**

**Abstract:** The efficacy of fish emulsion in enhancing plant growth and suppressing seedling damping-off diseases caused by *Rhizoctonia solani* and *Pythium aphanidermatum* was investigated on peat mix and soil. Fish emulsion (1%–4%; *m/m* peat mix) or equivalent inorganic fertilizer (N–P–K) was incorporated into pathogen-infested peat mix and incubated in plastic bags for 1, 7, 14, and 28 days prior to planting radish or cucumber seeds. Plants were rated 14 days later for incidence and severity of damping-off. Negligible protection of seedlings from damping-off occurred in peat mix incubated for 1 day with fish emulsion. After 7 days incubation, however, 70%–80% of the seedlings remained disease-free in peat mix amended with 4% fish emulsion. After 28 days, equivalent levels of disease protection were found with all concentrations of fish emulsion. As the inorganic N–P–K treatment was adjusted to reflect N–P–K levels in the fish emulsion, no disease control was obtained, indicating that disease protection was not due to increased plant nutrition. Incorporation of 0.5% (*m/m* soil) fish emulsion into soil 5 days before planting radish provided effective control of damping-off disease. Fish emulsion (2% and 4%; *m/m* muck soil) also effectively and consistently suppressed damping-off of cucumber seedlings in muck soil naturally infested with damping-off pathogens. Pasteurization of the peat mix followed by re-infestation with *R. solani* resulted in a much higher level of disease than that obtained in unpasteurized infested peat mix. Addition of fish emulsion resulted in restoration of disease suppression within 7 days. These results suggest that fish emulsion may not be toxic to the pathogens but may create a biological climate in peat substrate or soil that is suppressive to the disease. Fresh and dry mass measurements of plants produced in 4% fish emulsion were 2 to 3 times greater than in nonfertilized peat but were comparable with those receiving equivalent N–P–K. The results suggest that fish emulsion has both nutritive value for plant growth as well as disease suppressive properties. Thus, it may be an ideal product for use in organic or conventional transplant production.

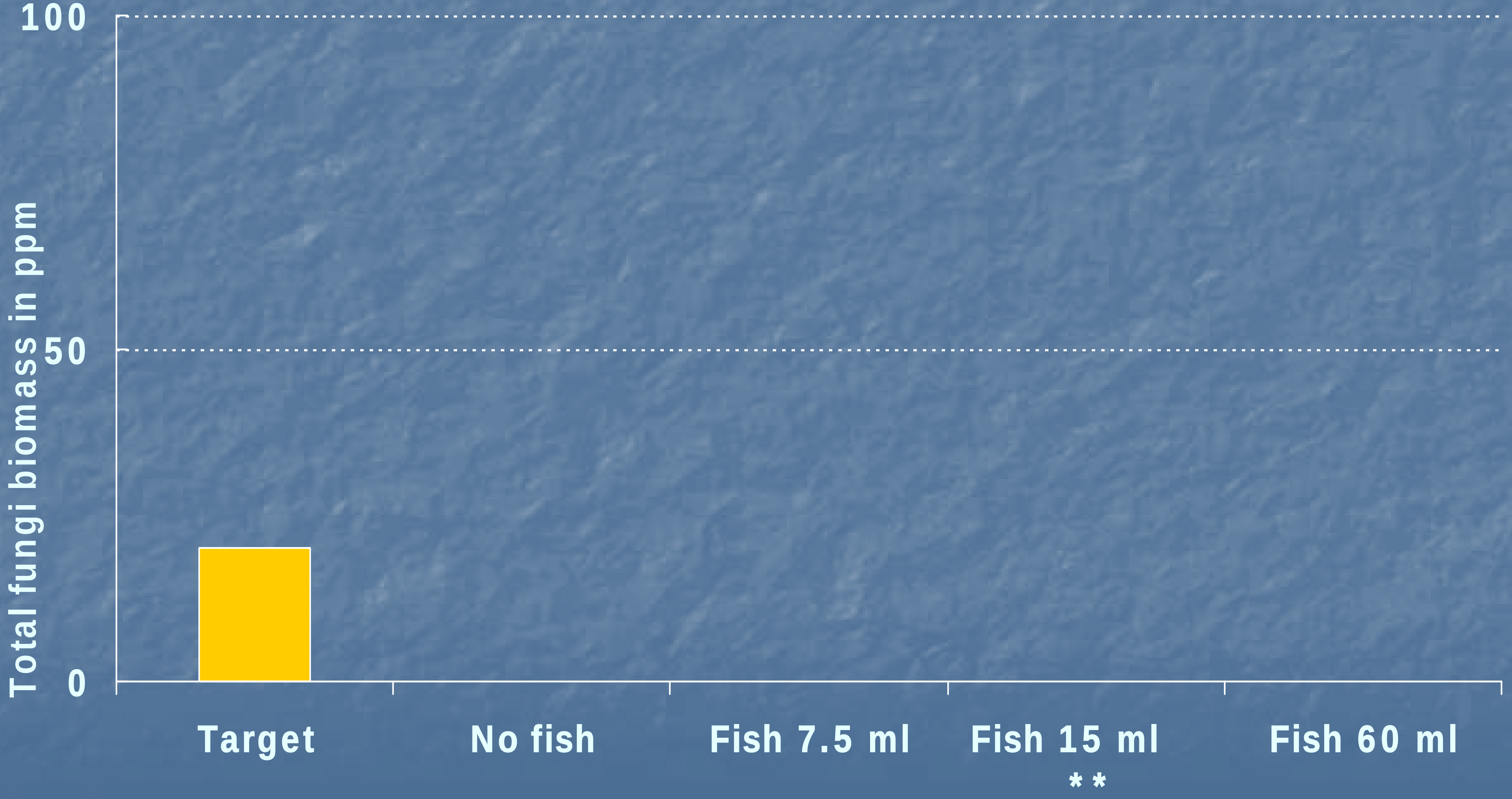
*Key words:* biological control, *Cucumis sativus*, disease suppression, organic amendment, *Pythium aphanidermatum*, *Raphanus sativus*, *Rhizoctonia solani*.

**Résumé :** La capacité d'une émulsion de poisson à améliorer la croissance des plantes et à inhiber la fonte des semis causée par le *Rhizoctonia solani* et le *Pythium aphanidermatum* a été étudiée dans un mélange de tourbe et dans du sol. L'émulsion de poisson (1–4 %; *m/m* de mélange de tourbe) ou son équivalent sous forme d'engrais inorganique (N–P–K) a été incorporé au mélange de tourbe infesté d'agents pathogènes et incubé durant 1, 7, 14 ou 28 jours dans des sacs de plastique avant que l'on y sème des graines de radis ou de concombre. Quatorze jours plus tard, la fréquence et la gravité de la fonte des semis ont été évaluées sur les plantes. L'incubation du mélange de tourbe durant une journée avec l'émulsion de poisson n'a procuré aux plantules qu'une protection insignifiante contre la fonte des semis. Cependant, après 7 jours d'incubation, 70 à 80 % des plantules n'avaient pas été atteintes par la maladie dans le mélange de tourbe additionné de 4 % d'émulsion de poisson. Après 28 jours, des niveaux équivalents de protection

# Fish fertiliser in compost tea

Impact on total fungi, results from Soil FoodWeb Canada, Jan 2006

Turbo SE 0-4-4 (*Ascophyllum n.*) in Bob's Brewer 5 gallon



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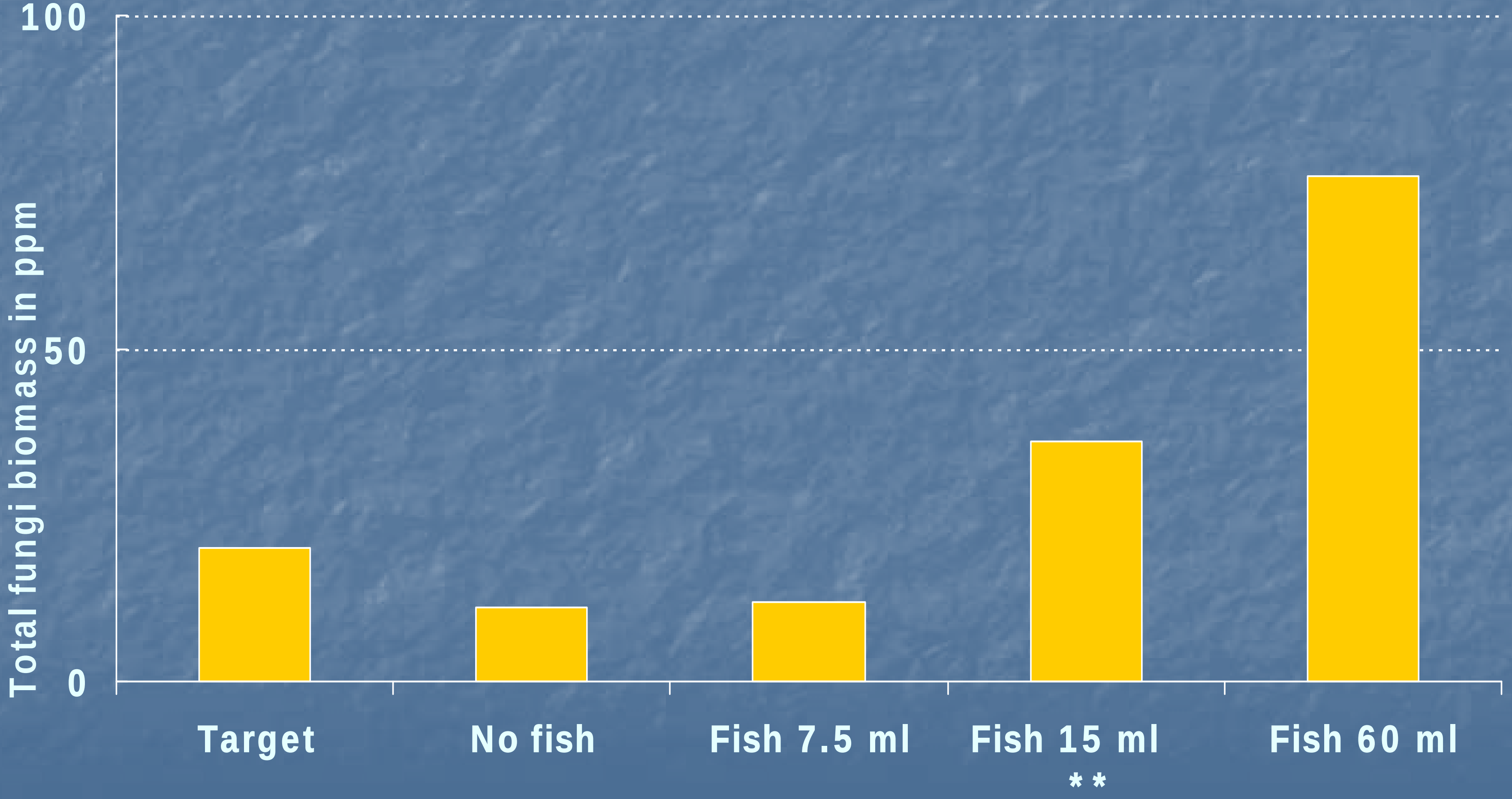


# Claims of larger vegetables with compost tea


Picture by Vic Zavala, SoilFoodWeb list serve, 2005

# Electrical Conductivity (E.C.)

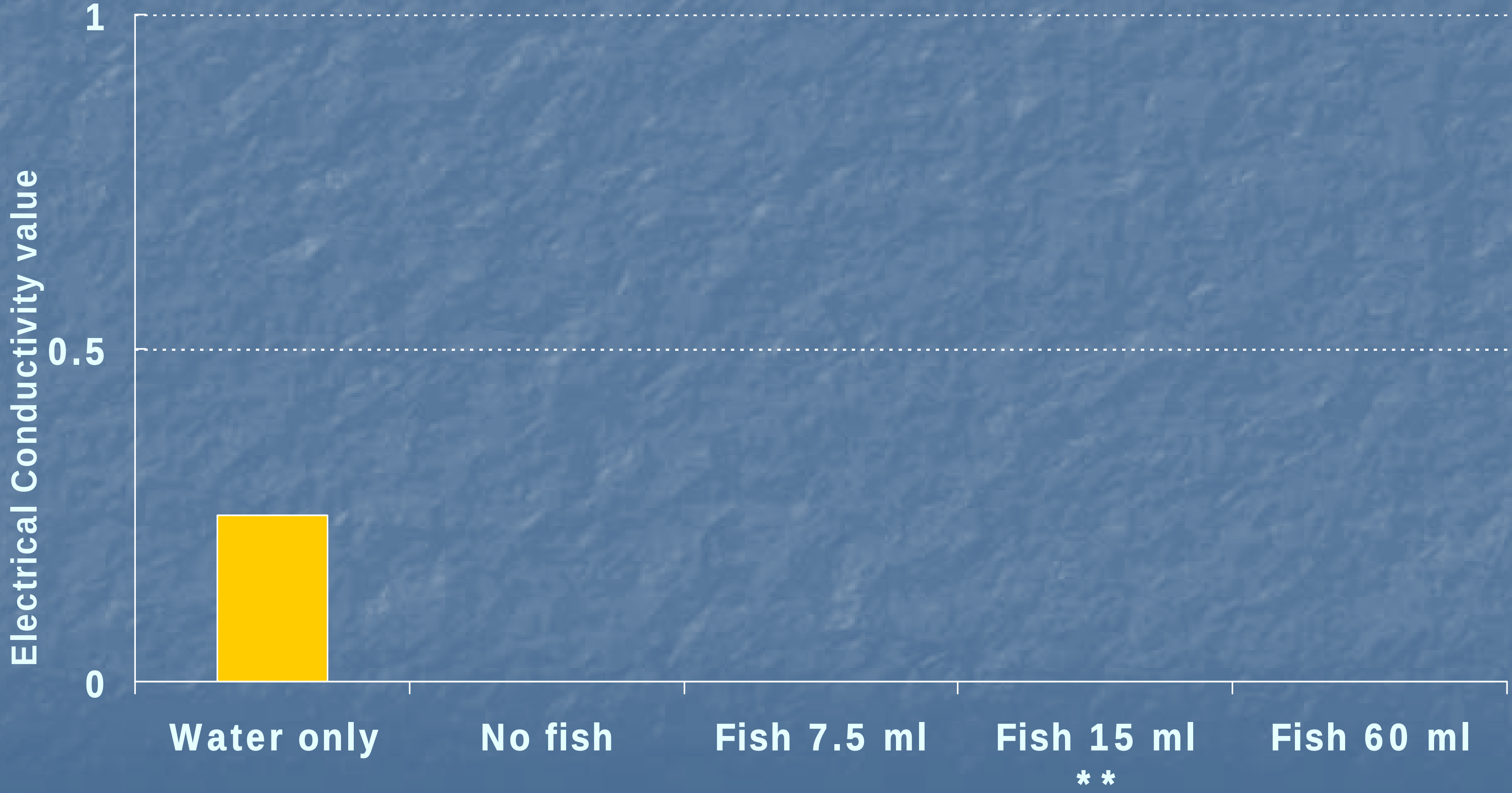
An indirect measure of fertiliser content

| E.C. | Typical use |
|---|---|
| 0.3 | Tap water |
| 0.5 – 0.75 | For seedlings |
| 0.75 to 1.25 | To grow plants |
| 1.25 to 1.75 | Rich fertilisation |
| Above 2.0 | Risk of salt injury |

# Fish fertiliser in compost tea

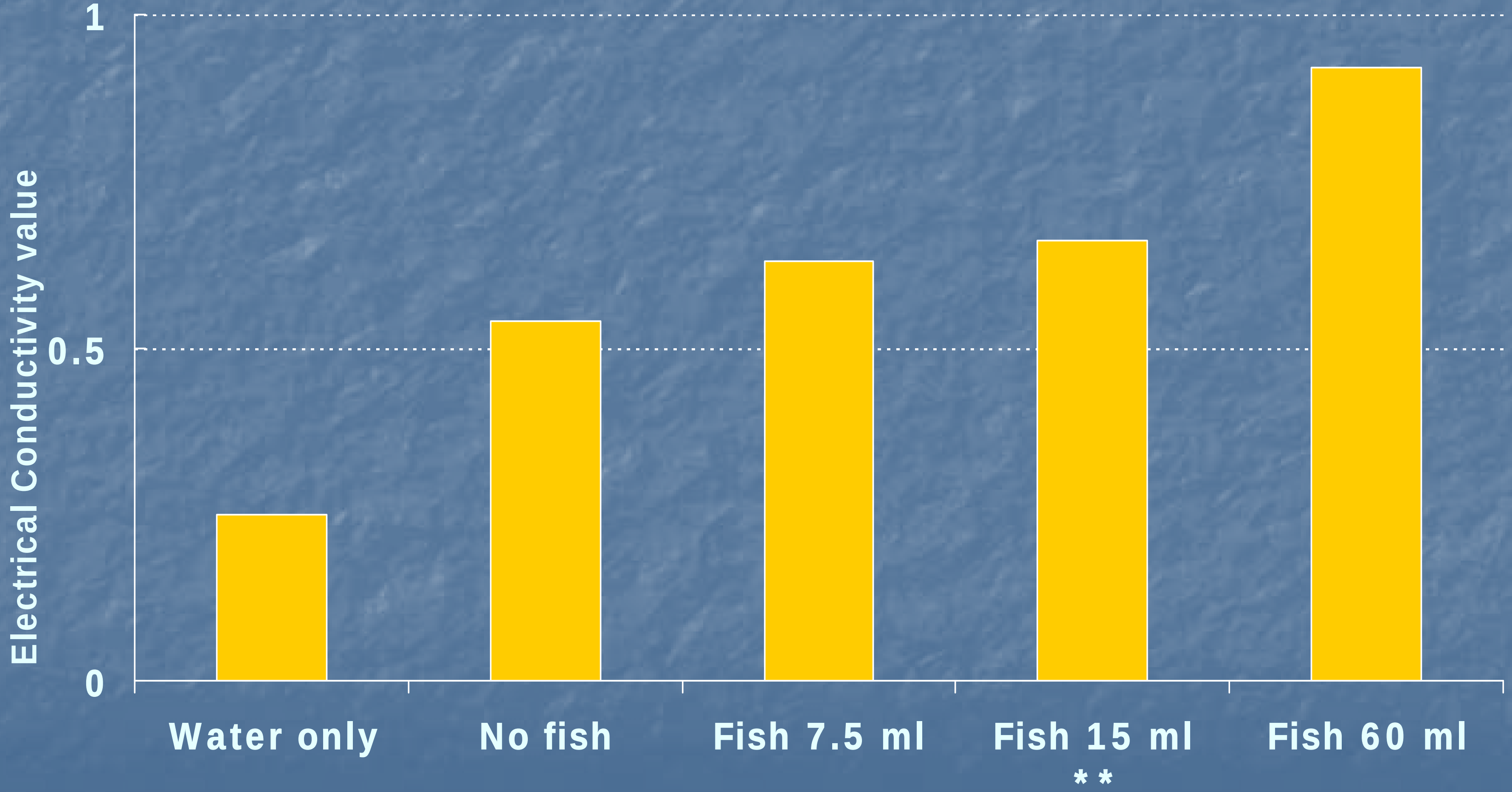
Nutrifish SE 2-3-1 (*Ascophyllum n.*) in Bob's Brewer 5 gallon

In-house testing with Hannah digital pens, January 2006



# Fish fertiliser in compost tea

Nutrifish SE 2-3-1 (*Ascophyllum n.*) in Bob’s Brewer 5 gallon
In-house testing with Hannah digital pens, January 2006



# Compost tea: nutrient quality

K.I.S. 5-gallon brewer + K.I.S compost and ingredients
Testing at Griffin Laboratories, Kelowna, 2004

| Analysis | Tap water (City of Kelowna) | Compost tea (K.I.S. commercial tea) |
| --- | --- | --- |
| pH | 7.6 | 5.6 |
| Conductivity | 0.20 | 2.70 |
| Nitrogen (ppm) | 0 | 118.0 |
| Phosphorus (ppm) | 1.1 | 10.3 |
| Potassium (ppm) | 7.9 | 418.6 |

# Are the larger vegetables from tea or from EC ?

Picture by Vic Zavala, SoilFoodWeb list serve, 2005

All good.

Next,
the raw data

# Humic acid in compost tea

Impact on total fungi, results from Soil FoodWeb Canada, Jan 2006

Tecologic Multi-dynamic Humic extract in Bob's Brewer 5 gallon

| Treatment | Bacteria (total, ppm) | Fungi (total, ppm) | Flagellate (# / ml) | Amoeba (# / ml) | Ciliates (# / ml) |
|---|---|---|---|---|---|
| Standard tea recipe | 8448 | 25 | --- | --- | --- |
| Humic acid only | 25 | 0 | --- | --- | --- |

# Humic acid in compost tea

Impact on total fungi, resuls from Soil FoodWeb Canada, Jan 2006

Tecologic Multi-dynamic Humic extract in Bob's Brewer 5 gallon

| Humic acid | Bacteria (total, ppm) | Fungi (total, ppm) | Flagellate (# / ml) | Amoeba (# / ml) | Ciliates (# / ml) |
|---|---|---|---|---|---|
| 0 ml | 8576 | 23 | 5753 | 831 | 0 |
| 15 ml | 10752 | 19 | 5753 | 1386 | 0 |
| 30 ml | 8960 | 72 | 5753 | 575 | 0 |
| 120 ml | 9344 | 15 | 5753 | 3570 | 0 |

# Different composts to prepare tea

Impact on total fungi, results from Soil FoodWeb Canada, March 2006
Glengrow and Byland's are yard waste; Nature's Gold is sewage sludge

| Treatment | Bacteria (total, ppm) | Fungi (total, ppm) | Flagellate (# / ml) | Amoeba (# / ml) | Ciliate (# / ml) |
|---|---|---|---|---|---|
| Glengrow | 5888 | 13 | 5753 | 4263 | 4 |
| Nature's Gold | 4736 | 14 | 152495 | 575 | 13 |
| Byland's young | 5504 | 18 | 13863 | 1386 | 4 |
| Byland's mature | 7808 | 35 | 138 | 46 | 5 |

# Vermicompost to prepare tea

Impact on flagellates, results from Soil FoodWeb Canada, Feb 2006
Nurturing Nature Organics, BC. Glengrow is composted yard waste

| Treatment | Bacteria (total, ppm) | Fungi (total, ppm) | Flagellate (# / ml) | Amoeba (# / ml) | Ciliate (# / ml) |
|---|---|---|---|---|---|
| Vermicompost 285 gr | 2432 | 37 | 5 | 460 | |
| Yard waste 485 gr | 3904 | 14 | 4606 | 277 | |
| Vermi 140 gr + Yard 240 gr | 6656 | 18 | 8318 | 1386 | |
| Vermi 285 gr + Yard 485 gr | 7936 | 16 | 27725 | 277 | |

# Activation of compost

Impact on flagellates, results from Soil FoodWeb Canada, Feb 2006

Oat flour mixed at 12% concentration (90 grams), Bob's Brewer 5 gallon

| Treatment | Bacteria (total, ppm) | Fungi (total, ppm) | Flagellate (# / ml) | Amoeba (# / ml) | Ciliate (# / ml) |
|---|---|---|---|---|---|
| Pre 6 days | 9856 | 130 | 57536 | 13863 | 4 |
| Pre 4 days | 9856 | 264 | 27725 | 3570 | 5 |
| Pre 8 hours | 8960 | 656 | 4606 | 2772 | 0 |
| At start | 10112 | 241 | 4606 | 2772 | 1 |

# Activation of compost

Impact on flagellates, results from Soil FoodWeb Canada, Feb 2006

Oat flour mixed at 12% concentration (90 grams), Bob's Brewer 5 gallon

| Treatment | Bacteria (total, ppm) | Fungi (total, ppm) | Flagellate (# / ml) | Amoeba (# / ml) | Ciliate (# / ml) |
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# Kelp in compost tea

Impact on total fungi, results from Soil FoodWeb Canada, Jan 2006

Turbo SE 0-4-4 (*Ascophyllum n.*) in Bob's Brewer 5 gallon

| Treatment | Bacteria (total, ppm) | Fungi (total, ppm) | Flagellate (# / ml) | Amoeba (# / ml) | Ciliates (# / ml) |
| --- | --- | --- | --- | --- | --- |
| Standard tea recipe | 8448 | 25 | --- | --- | --- |
| Seaweed only | 112 | 0.1 | --- | --- | --- |

# Kelp in compost tea

Impact on total fungi, results from Soil FoodWeb Canada, Jan 2006
Turbo SE 0-4-4 (*Ascophyllum n.*) in Bob's Brewer 5 gallon

| Kelp | Bacteria (total, ppm) | Fungi (total, ppm) | Flagellate (# / ml) | Amoeba (# / ml) | Ciliates (# / ml) |
|---|---|---|---|---|---|
| 0 ml | 8832 | 20 | 5753 | 575 | 1 |
| 15 ml | 10240 | 28 | 35700 | 1525 | 2 |
| 30 ml | 9344 | 25 | 27725 | 2772 | 0 |
| 120 ml | 9856 | 88 | 27725 | 426 | 0 |

# Fish fertiliser in compost tea

Impact on total fungi, results from Soil FoodWeb Canada, Jan 2006
Turbo SE 0-4-4 (*Ascophyllum n.*) in Bob's Brewer 5 gallon

| Treatment | Bacteria (total, ppm) | Fungi (total, ppm) | Flagellate (# / ml) | Amoeba (# / ml) | Ciliates (# / ml) |
|---|---|---|---|---|---|
| Standard tea recipe | 8448 | 25 | --- | --- | --- |
| Fish only | 243 | 0.3 | --- | --- | --- |

# Fish fertiliser in compost tea

Impact on total fungi, results from Soil FoodWeb Canada, Jan 2006

Turbo SE 0-4-4 (*Ascophyllum n.*) in Bob's Brewer 5 gallon

| Fish fertiliser | Bacteria (total, ppm) | Fungi (total, ppm) | Flagellate (# / ml) | Amoeba (# / ml) | Ciliates (# / ml) |
|---|---|---|---|---|---|
| 0 ml | 9344 | 11 | 13863 | 4606 | 3 |
| 15 ml | 896 | 12 | 3570 | 3570 | 4 |
| 30 ml | 7552 | 36 | 13863 | 277 | 1 |
| 120 ml | 9472 | 76 | 5753 | 3164 | 0 |

# Traditional method - Compost tea from steepage

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## Compost Tea for Organic Farming and Gardening

*By William Quarles*

Gardeners who want to avoid fungicides, golf course superintendents who want to reduce their dependence on chemicals, and organic farmers who must avoid chemical pesticides can all benefit

*Photo courtesy Dan Dinelli*

**Compost teas can be produced by home gardeners, organic farmers, and others. Here, compost tea is being prepared by the "teabag" method for use on a golf course.**

nutrients in composts can also make plants stronger and more

As well as plant nutrients, compost teas contain microbials, espe-

# Steepage vs Actively aerated

Impact on biology, results from Soil FoodWeb Canada, March 2008

Steepage recipe from Al-Dahmani *et al.* Ratio is volume of compost to volume of water

Actively aerated from Bob's Brewer 5 gallon

| Treatment | Bacteria (total, ppm) | Fungi (total, ppm) | Flagellate (# / ml) | Amoeba (# / ml) | Ciliates (# / ml) |
|---|---|---|---|---|---|
| Steepage 1:3 | 14720 | 16 | 1386 | 2772 | 5 |
| Steepage 1:5 | 11776 | 19 | 1386 | 1386 | 5 |
| Steepage 1:15 | 1114 | 6 | 138 | 138 | 4 |
| Aerated | 5376 | 9 | 135 | 575 | 1 |

Compost tea:

Can we *really* turn water into gold ?