BioComplete™ Liquid Amendments

Lecture 3 – General Concepts (Part 1)

Topics

Definitions

BioComplete™ Compost / Extracts / Teas, Leachates, Ferments, Manure Tea, Put-to-Sleep Teas

General Concepts

Assurance of Success, Foods, Biomass levels, Diversity, Water Quality, Temperature, Aeration

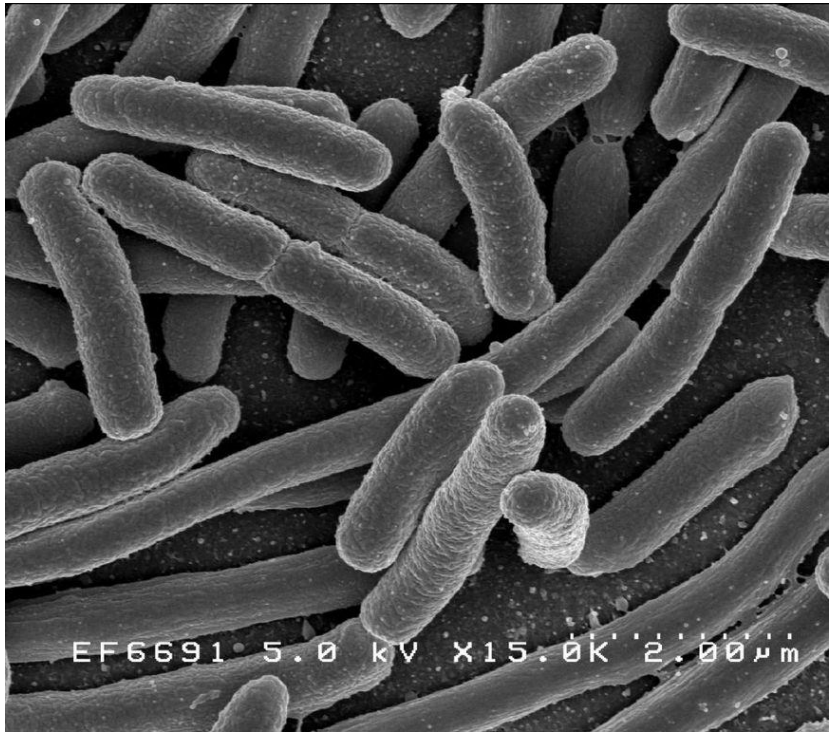
Extracts - Massaging, Duration, Storage

Teas - Foods, Extraction, Aeration, Duration

Application – Pumps, Timing, Cleaning

Bacterial Foods

Simple sugars, amino acids, proteins, carbs, plant sap, juices, young plants with C:N around 30:1.



The more branched and longer the carbon chains, the less likely bacteria can compete with fungi for this food.

Bacteria generally make one enzyme at a time, attached to the cell wall, so the more diverse their food, the slower decomposition will be, and the more likely fungi will win.

Fungal Foods

Complex organic compounds, lots of branches, long chain, high molecular weight, condensed tertiary structure. Examples, seed coats, ground meals, fish oil, fish hydrolysate, kelp, fulvic, humic acids.

The more branched, the longer the carbon chains, the more likely fungi will win.

Fungi generally make many enzymes, which are sent out into the world to attack many different materials at the same time. The hyphae grows towards the highest concentration of decomposed foods.

Test Bacterial / Fungal Foods

Some foods that grow fungi well in one location may not grow fungi in another location. For example, fungal foods the grew fungi well in Oregon did not grow any fungi in southern California. Conclusion: Testing is needed.

Place a handful of moist soil or BioComplete™ Compost in each clear cup. Add the smallest reasonable amount of the food (see directions on package or do three or four concentrations). Mix the food in or leave layered on top based on your field plan. Monitor for growth of the desired organisms over 10 to 14 days. Determine whether your fungi can use that food.

Compost slightly darker than the 70% cocoa, good aggregates, air passageways.

Rich Cocoa Color

=

Good Humic Acids

Significantly darker than the 70% cocoa, no aggregates, no air passageways.

Honey yellow color indicates fulvic acids present, no humics.

Be Aware of These Things with Foods

1. Check to make sure salt levels are not excessive in the food product.
2. Any store-bought product will have a preservative in it to prevent growth of organisms. No preservative? The sealed container will bulge or blow up from the gas released as the organisms grow.
3. Check the label to determine how to neutralize the preservative. Typically addition of enough water will dilute the preservative adequately.
4. Check C:N ratios to prevent “party food” responses
5. Molasses is usually a bacterial food, but at high concentrations, no free water is present and microbes and plants may die.

Developing BioComplete™ Tea Recipes

1. The amount of any added food should be based on the quick tests done to determine what foods grew the indigenous fungi and bacteria.
2. Addition of foods should result organism growth, but not so much that oxygen is used up faster than oxygen can diffuse into the tea.
3. For small 5 gal brewers, additions should initially be in the 1 to 5 teaspoon range. Larger brewers should increase those amounts based on increased volume.

Initial BioComplete ™ Tea Recipe

- Add foods to tea brewer water BEFORE any organisms are added.
- Typical starting point in a 500 gal brewer is 2 cups of kelp, 1 cup of humic acid OR 1 cup of fish hydrolysate, perhaps 1 cup of oatmeal or steel ground oats.
- Add 7 to 10 pounds of BioComplete™ Compost into the brewer bag, run an air line from the air pump into the bag so BioComplete™ Compost is constantly mixed, aerated and organisms extracted.
- BioComplete™ Compost needs to have a MINIMUM of the following organisms groups:
    - 300 ug/g high diversity bacteria
    - 300 ug/g beneficial fungi
    - 10,000/g flagellates and amoebae
    - >100 beneficial nematodes/g

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How Much BioComplete™ Compost to Use?

- Other researchers have observed positive results from adding around 400 pounds of compost per acre, but then they were not always able to repeat those results.

- When this happens, it is clear that some important factor was not been documented.

- Time of year? Type of OM? Application method? Different crops?

How Much BioComplete™ Compost to Use?

- What was not known was:
  1. What the biology was in the compost
  2. What the biology was in the soil

- We need some biological ranges to determine how much BioComplete™ Compost and food to add given the low, medium or high levels of organisms in the BioComplete™ Compost.

- Also, how much biology needs to be applied if the soil is poor, medium or high level.

Example Levels for Organism Groups in BioComplete™ Compost, Extract, or Tea

These values are MINIMUM GUIDELINES applied at 1 ton/acre. Note the balance of the different groups as well:

Organisms	Minimum Counts
Total Bacteria	300 micrograms/gram
Total Actinobacteria	<16 micrograms/gram (higher for brassicas)
Fungi	300 micrograms / gram
Protozoa	F+A 10,000++; C < 100
Nematodes	Bf+Ff+Pred > 100; Rf - None

No disease, pest or problem organisms.

How Much BioComplete™ Compost to Use?

What if the BioComplete™ Compost has half the needed fungal amount?

- Then you need to double the amount of compost.
- Apply 2 tons/acre.

What if protozoa are 1/100th of what is needed?

- Then add a protozoan infusion into the BioComplete™ Compost before applying.
- This also takes care of high bacterial biomass.

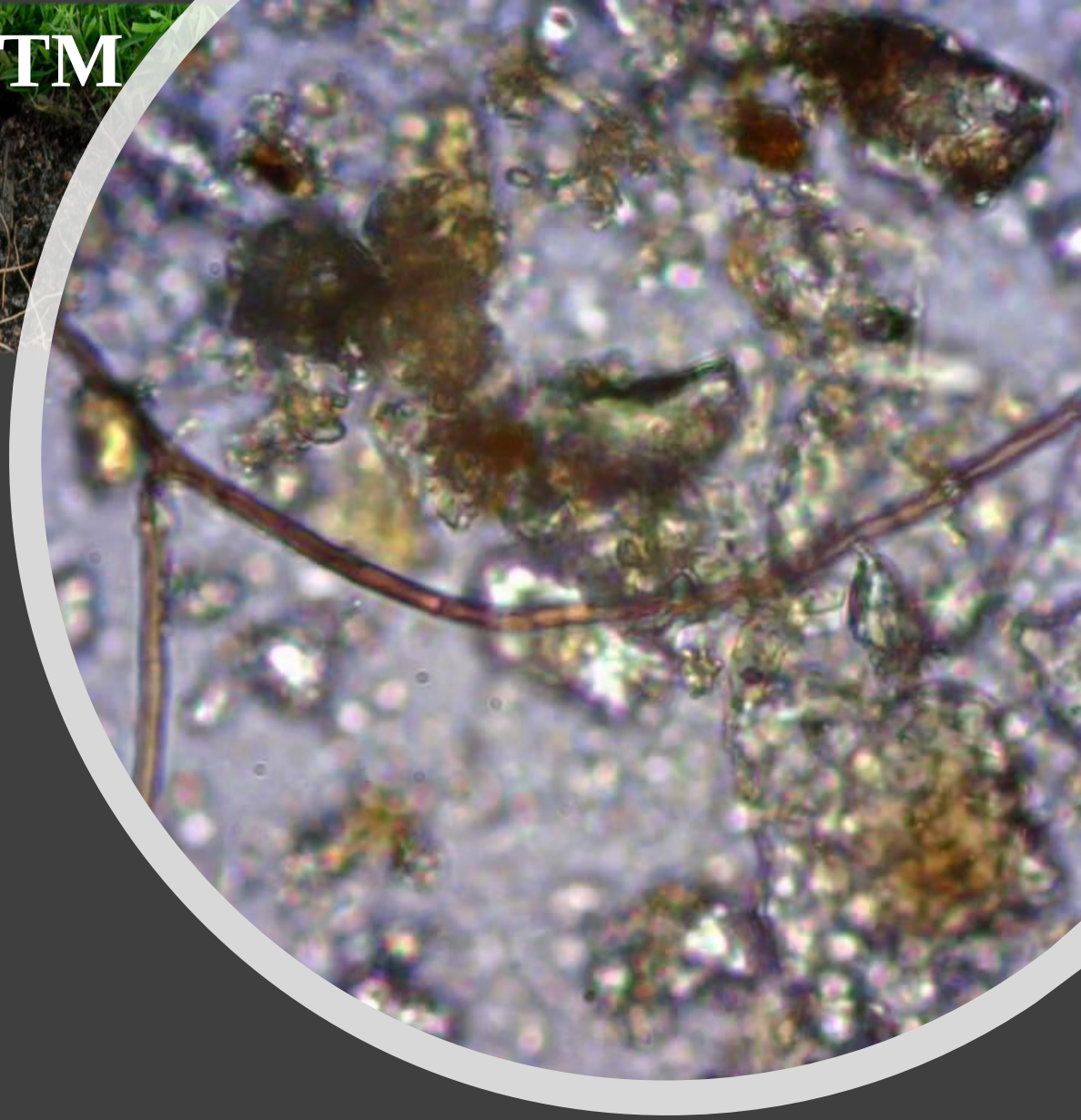
What if beneficial nematodes are low?

- Then add a nematode extract.

How Much BioComplete™ Compost to Use?

- We need to consider what crop is being grown.
- What successional F:B ratio is needed?
- Application of more BioComplete™ Compost might be needed to increase fungal amount added to the field.
  - Possibly increase BioComplete™ Compost addition to 2 tons be acre or add fungal foods when the BioComplete™ Compost is applied.
- More bacterial-feeders could be added to drop bacterial biomass.

How Much BioComplete™ Compost to Use?



Take into account the biology in the soil.

Figure out if the biology in the soil was:

a) poor (just B, nothing else home?)
b) low (lots of B, low in F, Prots and Nema)
c) minimum (see previous slide)
d) excellent (F and B each 600 micrograms, 50,000+ flag and amoebae, >100 Bf+Ff)
e) Outstanding (double the excellent levels)

How Much BioComplete™ Compost to Use?

- If the soil is poor (see previous slide), and the compost has minimum biology, think about applying 2 tons / acre with additional foods, protozoa and nematodes, followed by the BioComplete™ Extracts applied at first true leaf, then monthly until the biology is what it needs to be for the plant.
- If the soil was low or minimum, then 1 ton/ac of the minimum biology compost is good, followed by BioComplete™ Extracts as normal.
- If the BioComplete™ Compost was excellent, perhaps only a half ton (1000 pounds) per acre, and with an outstanding BioComplete™ Compost, 500 pounds would probably do the transition. Of course, I'd always do the BioComplete™ Extracts, just to be safe.
- And MONITOR!!!!!! Make no assumptions!

Biomass Levels in BioComplete™ Extracts and Teas

- Why is it we don’t have to add the exact number or biomass of organisms that have to be in the soil?
- Microbes reproduce! We only need to give them the place to thrive.
- Add enough organisms to make sure they are present, make sure enough food is present, and the habitat stays aerobic so the beneficials grow.
- Recall the work done with BioComplete™ Compost.

Organisms After BioComplete™ Compost Addition

Organisms	Agricultural Field	BioComplete™ Compost (1 ton/ac)	Two weeks later
Total bacteria (µg/g dry soil)	300	2000	800
# bacterial sp/g soil (DNA)	5,000	75,000	75,000
Total fungi (µg/g dry soil)	5 (i.e., dirt)	950	650
# fungal species /g soil (DNA)	500	25,000	25,000
Protozoa: F, A C	0, 0 1,450	12,000, 31,000 29	6,000, 17,000 67

Biomass Levels in BioComplete™ Extracts and Teas

- Note that **no additional foods** were added to this dirt.

- **Only BioComplete™ Compost was added**, at the rate of 1 ton/ac spread out on the rows where the plants were going to be planted. There were foods in the dirt as well, at 1% OM, so not much food, but every little bit helps.

- Plants were planted in the soil immediately after the BioComplete™ Compost was tilled in (to break up compaction) and this adds foods to the soil to help microbial growth.