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Building an Ecosystem in Your Container

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Summary

Evolution created a symbiotic relationship between plants and beneficial microbes that when properly implemented will produce healthier plants more economically and sustainably. By working with a more sustainable plant ecosystem – via incorporation of microbes to the plant rhizosphere – plants are healthier, more resistant to pests, require fewer chemical inputs, mitigate potential pollution problems, create a safer workplace – and ultimately, produce crops more economically.

INTRODUCTION

Microorganisms (microbes) are crucial for all ecosystems from the human body to farmlands, to all areas of the world and to earth itself. We humans would not exist without beneficial microbes. In fact, over half the cells in the human body are non-human – composed of bacteria and other organism in our microbiome. In humans, ben-

eficial microbes are part of our immune system and have great influence on the way we think.

The same holds true for plants. Higher land plants could not have come into existence 460 million years ago without the aid of microbes (McNear, 2013). This is natural law at work. Evolution created a symbolic bond between plants and beneficial microbes that when appreciated, will grow healthier plants with less expense and less work (Harman, et al., 2021). Meaning, ensure that your soil ecosystem is thriving with beneficial microbes. That is easy to do. Just introduce them to your soil/media system and support them with good microbial foods, judiciously use chemical fungicides and make sure there is sufficient oxygen availability – for a healthy, aerobic root system environment.

All the science and data are there. While relatively new to horticulture, the study and use of microbes for plants and humans has become increasingly important (Davies, 2008). Simply put, without a good microbial system in place - all humans, animals and plants would not exist.

Unfortunately, most American do not have a healthy gut microbiome and therefore America leads the world in all categories of chronic illnesses. Poor health causes premature death, lingering sickness, huge medical bills and impairs the quality of life. The same holds true for most plants grown and maintained in America. The gut microbiome for the plants is the soil (plant rhizosphere); and if soil is not healthy - then plants are not healthy. Soil gut health, like human gut health, is determined by inputs - that determines whether good microbes or bad microbes flourish. Unsuitable inputs for humans include super-processed foods, pesticide sprayed fruits and vegetables, and foods with low nutrient density.

Bad inputs for the soil rhizosphere are unsustainable use of chemical pesticides, particularly chemical fungicides, and high salt chemical fertilizers. These will kill the good microbes, and the vacuum created will be filled with nothingness or dominated by bad microbes.

A soil system dominated by bad microbes will weaken a plant's ability to grow and defend itself - which means more inputs are required to keep them alive to the sellable stage.

We analyzed typical growers' soil/media (aged pine bark) for microbial activity. The untreated soil was very low in microbial activity. Then we added a bio-inoculant to the same soil and the numbers had a huge increase (**Table 1**). We then followed some of the plantings inoculated, measuring the microbial count at 30 days, 60 days and 90 days and found significant microbial counts. The numbers can be quite staggering (**Table 2**). A large number of microbes can be introduced to a 4-in (10 cm) square pot (**Table 3**).

Table 1. Soil microorganisms in inoculated and non-inoculated, aged pine bark.

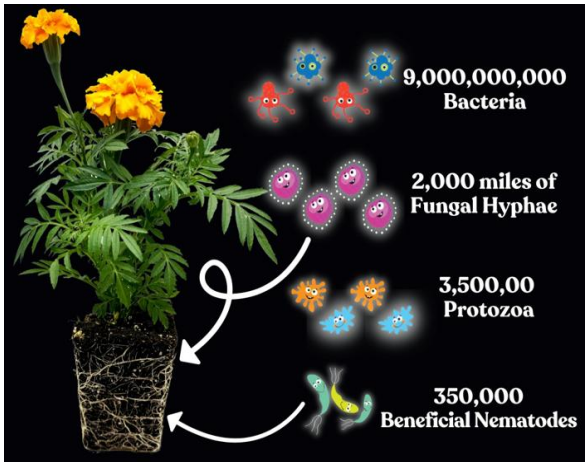
Aged Pine Bark l Laboratory Count CFU Per Gram

ORGANISM	NO INOCULATION	WITH BIO INOCULANT
Bacillus - Paenibacillus	1.4×10^6	$32{,}000 \times 10^6$
Pseudomonas	0	85×10^7
Streptomycetes	0	3.0×10^6
Trichoderma	0	1.5×10^6
Glomus	0	930

Table 2. Two 90-day bioinoculant trials.

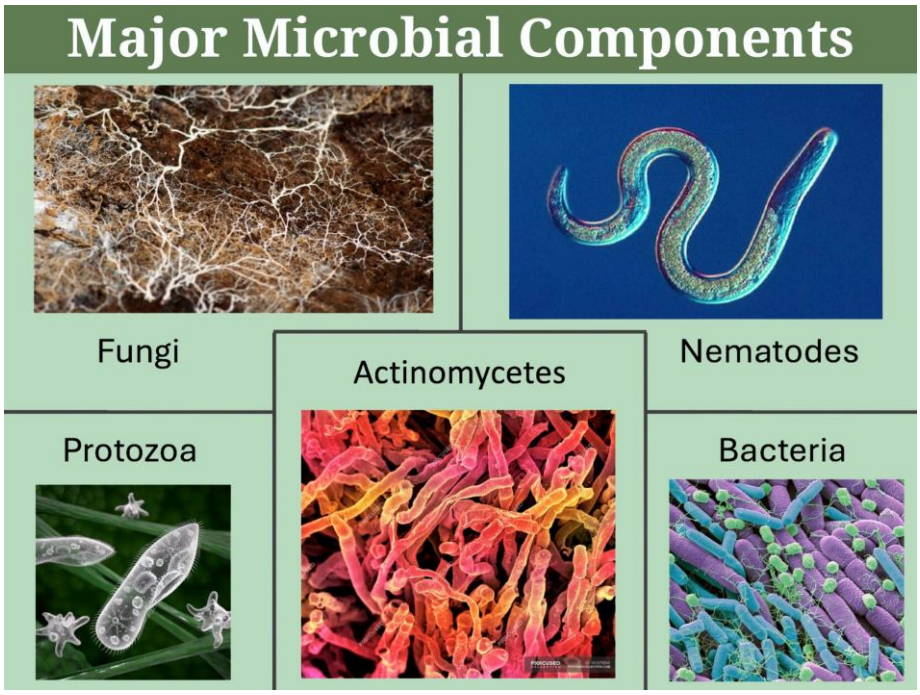
BIO INOCULANT TRIALS - 90 DAYS			
SAMPLE ID	TOTAL COUNT	NON-MYCORRHIZAL COUNT (BACILLUS, PSUEDOMONAS, STREPTOMYCES, TRICHODERMA)	MYCORRHIZAL FUNGI COUNT
Bio 1 - March	1.200×10^7 cfu/gm	1.160×10^7	4.000×10^5 cfu/gm
Bio 1 - April	3.000×10^8 cfu/gm	2.998×10^8	2.000×10^5 cfu/gm
Bio 1 - May	4.000×10^9 cfu/gm	3.99965×10^9	3.500×10^5 cfu/gm
Bio 2 - March	3.600×10^7 cfu/gm	3.550×10^7	5.000×10^5 cfu/gm
Bio 2 - April	6.000×10^8 cfu/gm	5.970×10^8	3.000×10^6 cfu/gm
Bio 2 - May	9.000×10^9 cfu/gm	8.995×10^9	5.000×10^6 cfu/gm

Table 3. Organisms in the plant rhizosphere.



So, who are the main beneficial microbes we are talking about? They primarily will fall into 5 groups: bacteria, fungi, actinomycetes, protozoa and nematodes (**Table 4**).

Table 4. Major plant rhizosphere microbial components.



There are opportunities with using mycorrhizal fungi to benefit nursery propagation and production systems (Davies, 2008). These beneficial microbes are your 24/7 work force that have a symbiotic relationship with plants. The plant directly supports the microbes through root exudates (carbohydrates, amino acids, organic acids, enzymes) - in exchange for benefits such as solubilization of immobile elements, increased nutrient uptake (extraradical hyphae of mycorrhiza), drought resistance,

pest resistance – and an overall - more healthy/resilient plant ecosystem.

Some of the essential benefits that plants will receive by having a healthy soil microbial population include:

- plant protection from soil disease and pest insects
- making more minerals available
- more extensive root system
- faster, healthier growth
- reduced production time & enhanced post-production longevity

To achieve high Brix levels, these conditions must be met:

- only use high grade fertilizers, quality organics are preferred
- have a healthy soil ecosystem; use bioinoculants as needed.
- judicious use of chemical fungicides
- resistance to abiotic stress

A management tool to measure plant health is a Brix refractometer (**Fig. 1**.). Brix measures the amount of sugar in a plant which equates to plant energy/health (Roe, 2021). The more energy a plant has, the healthier it is. If you can get to a Brix reading of 15, the plant is basically bullet proof to most insect pests and diseases. Brix measurement is simple and fast. Plant leaves are pressed to drop liquid plant sap on the Brix refractometer or hydrometer - and the reading is immediate.

Figure 1. A refractometer is used to measure the leaf Brix which is the carbohydrate/sugar concentration as a percentage. Testing the Brix leaf sap with a refractometer is a quick way to determine plant health.

- reduce stress, do not over-water, etc
- foliar spray with combinations of fish, seaweed, molasses, humic acid

Foliar spray with combinations of fish, seaweed, molasses, humic acid can raise the photosynthetic efficiency which equates to healthier plants and soils.

CONCLUSION

The world of organics, soil microbiology and nutrition is fascinating and provides a lifetime of exciting learning. By working with a more sustainable plant ecosystem – via incorporation of plant microbes to the rhizosphere – plants will be healthier, more resistant to pests, require less chemical usage, mitigate potential pollution problems, create a safer workplace – and ultimately, produce crops more economically.

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