Great Big Plants
Biological Control

Bio-Bits	
Complements of Www.Farmerssecret.com	Spring 2000

Soil Food Web

What does a healthy soil look like?

There are several million to billions of organisms, which typically require a microscope to see, that live in soil and around the roots of plants. The way these organisms interact with each other and with plants is called the Soil Food Web. There is a best balance of all the different kinds of microorganisms for each kind of plant to get best plant health and quite often improve yield. A spoonful of healthy soil should contain only beneficial species of bacteria, fungi, nematodes and protozoa that never cause disease or become pests. These species perform vital "functions" in the root zone that can bring real profits to growers IF soil conditions are managed in ways that allow the microbes to live and work.

Think about the dollar potential involved with each of the following six functions and then be aware that these functions are entirely biological and only occur through a soil foodweb that is built up, intact and working!

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A balanced Soil Food Web will:
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1. Suppress disease-causing and pest organisms
2. Retain nitrogen and other nutrients such as calcium, iron, potassium, phosphorus, etc.
3. Make nutrients available for plant growth at the times plants require at the rates plants require.
4. Decompose plant residues rapidly.
5. Produce hormones that help plants grow.
6. Produce good soil structure, improving water infiltration, oxygen diffusion, and water-holding capacity.
7. Consume pollutants in the soil.

Disease suppression: Requires specific species of bacteria and fungi that compete with, inihibit and parasitize disease-causing organisms. The plant uses a minimum of 25% of it's fixed energy each year to feed these beneficial organisms in the volume of soil around it's roots. If pesticides or high levels of fertilizers have been used, or if plowing has been too intensive leaving bare soil for significant periods during the year, these beneficial organisms are no longer present. The exudates the plant makes feed disease organisms, and we see ever-increasing disease problems. The beneficials have to be brought back through inoculation if their numbers are too low, or through feeding the right kinds of foods that select for the "good guys", and not the bad guys.

A healthy soil that contains a broad diversity of microbial types most often contains species that consume, inhibit or suppress the kinds of fungi that cause root rots and the kinds of nematodes that attack roots. There is plenty of research and on-farm experience to show that these economic threats can be controlled very well without the need for applied fungicides or nematicides. What it takes for this to happen is good soil health in the form of an active, intact soil foodweb. Retention of nutrients: Nitrate and some other nutrients can leach out and be lost unless they can be banked in soils until the plant needs them. The function of nutrient retention occurs when bacteria and fungi multiply and increase their populations in the soil. Bacteria and fungi are extremely rich in protein that is made from nitrogen. When bacteria and fungi multiply they gather nitrates, ammonium, and organic nitrogen from the soil and convert it to protein in their bodies. Nitrogen in this form is a bank account of nitrogen that does not leach easily and is not lost as a gas.

Products and cultural practices that stimulate a "bloom" of bacteria or fungi reproductive growth can be used as tools to achieve nutrient retention. When this function is working in your soil, half of the process that leads to lower rates of N and P with no reduction in crop yield is present. You are retaining N, P, S, Ca, K, Fe, etc, in your soil, and they will NOT end up in surfGreat Big Plants-Soil Imunity Booster or groundwater any longer. Recent studies at SFI have shown that fungi are the most important retainers of calcium in the soil. Lose your fungi, and you lose the ability to retain Ca in the soil.

Nutrient Recycling: Once nutrients have been retained, other kinds of soil organisms need to be encouraged to feed on the bacteria and fungi. In bacterial-dominated soils, the rich meal of protein in the bacteria and fungi that the predators eat is metabolized and part of the nitrogen is released back into the soil as ammonium that is quickly converted to nitrate for use by crops. In fungal dominated soils, since fungi produce organic acids, ammonium remains as ammonium, and little is converted into nitrate. Look at the form of nitrogen in healthy orchard or conifer forest soils - it is ammonium, not nitrate, that is the major form. Forests/orchards where nitrate is higher than ammonium are typically in severe stress, with dying trees. The organisms that release nutrients from the bacteria and fungi (the retained form) are beneficial nematodes that only feed on bacteria or fungi, protozoa that feed on bacteria, and beneficial soil mites that feed on fungi. As these species go about their work they cause nitrogen especially, but also phosphorus and other nutrients, to be released at a gradual rate that supplies crops with a steady diet all season long.

Decomposition of crop residues, manure and other organic material: These materials will only decompose if certain species of fungi and bacteria, the "decomposers", decay them and allow recycling processes to occur. The ideal process forms large amounts of humus. The decay function gets rid of crop residues, but what it really does is convert the food energy in fresh organic matter to biological forms that feed other soil organisms that do different indispensable functions, as described below.

Production of plant growth regulators: All plants depend on the presence of certain species of soil microorganisms in the root zone to produce various hormones and other chemical "signals" that stimulate growth and development. Two plants from the same seed, one in a dead soil and the other in a living soil, both with the same nutrients, will show different rates of growth, final size and value. The plant growing in healthy soil will have found the partnership it expects with beneficial microbes that produce growth hormones not made by the plant itself. The plant in healthy soil will be the better plant.

Soil structure: In order to maintain an well-aggregated soil structure, i.e., to improve or maintain good tilth, the organisms that glue, bind and engineer soil structure and soil pores must be present. Good tilth or good soil structure allows optimum infiltration of air, water and roots. Aggregates will not form unless sand, silt and clay particles are "glued" together by the gums and gels that many species of soil bacteria produce. These aggregates are further strengthened against collapse by species of beneficial fungi that grow throughout the aggregate and physically bind it. The large pore spGreat Big Plants-Soil Imunity Boosters holding "reservoirs" of water must be built by the larger critters, by microarthropods, earthworms, beetle larvae, enchytraeids, etc. The better the set of soil organisms producing resilient structure, the more "strength" your soil has. The more resilient the structure of the soil, the bigger the equipment that can be driven on it, without destroying that structure.

Clean up of herbicide or pesticide carry over: Most herbicide and pesticide molecules can be "eaten" or degraded by certain kinds of microbes in the soil, if those species are present. A healthy soil will tend to rid itself of ag chemical carry over and other forms of pollution. Each of the functions above describes how soils are supposed to work and can work. Your opportunity is to learn to employ cultural practices and biological products to get all these functions working at top capacity.

Yield and profit will be the result.

Dr. Elaine Ingham
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Q&A Session #1
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Q1:
I would like to understand the mechanism of beneficial nematodes affecting root-feeders. Do these beneficial nematodes survive thermal composting cycles?

A1:
What we find is that root-feeding nematodes can be suppressed by having a healthy number of bacterial-feeding nematodes, fungal-feeding nematodes and predatory nematodes present in the rhizosphere. "Healthy" numbers depend on the plant, the soil type, climate, hydrology, etc, so we expect that the number is different based on circumstances. The mechanisms for interactions between these beneficial nematodes and the root-feeding nematodes is something nematologists at a variety of Universities, including my husband at Oregon State University, have been interacting on for a number of years. Nothing extremely formal, certainly not funded by any government agency that I am aware. Right now, the hypothesized explanations for how beneficial nematodes control root-feeding nematodes are:

1. Physical impediment. The beneficials interfere with the ability of the pest nematodes to find the root. This could be by occupying spGreat Big Plants-Soil Imunity Booster along the root so the pests don't have room to "belly up to the bar". It could be that beneficials physically bump and push the pest nematodes out of the rhizosphere.

2. Stimulating growth of bacteria or fungi that produce antibiotics or other pest nematode inhibitory compounds. When bacterial- or fungal-feeding nematodes graze their prey, the release of nutrients stimulates the remaining prey to grow faster. This is a culling phenomenon. The stimulated bacteria or fungi may make compounds that kill the pest nematodes. But in order for this mechanism to work, not only must the beneficial nematodes be present, but the right species of bacteria and fungi need to be present.

3. Inoculation of the rhizosphere with bacteria and fungi that trap and parasitize pest nematodes. There are many species of bacteria and fungi that if they can gain entrance to the inside of a nematode, will cause disease, or will parasitize the nematode. Large numbers of nematodes - beneficials or pests - means the diseases of nematodes will eventually arrive too. Maybe that's all that happens - the beneficials bring nematode diseases with them and trash the neighborhood, at least from the root-feeding nematode's point-of-view.

4. Consumption of pest nematodes. Predatory nematodes eat other nematodes. It's not really cannibalism, but more like people eating great apes, or one species of spider eating another species of spider. But the more predatory nematodes present, the more root-feeders will be eaten. It is likely that some species of predatory nematodes specialize in hunting down root-feeding nematodes, so those would be the most effective species to inoculate. Which species are those? It depends on the soil, climate, plant species and pest nematodes present, but the best plGreat Big Plants-Soil Imunity Booster to look for this information is in the Journal of Nematology and to talk with your local nematologist. They may not know this kind of information, but perhaps they should be encouraged to do so.

We have developed a group of beneficial nematodes that, when added to soil, interfere with root-feeding nematodes. The comparison of control versus treatments show reductions in root-feeders on addition of bacterial-feeding, fungal-feeding and predatory nematodes. But SFI does not sell products. We test to see if nematodes are present and which kinds are present. Are they the right ones, based on climate, soil type, plant desired, etc? We assess whether the other organisms - bacteria, fungi, protozoa, mycorrhizal colonization - are correctly balanced for a healthy soil to grow the desired plant. But, the beneficial nematode "inoculum" is a product that ought to be available to growers. Right now, SFI is willing to send this inoculum to people, but only if you agree to test your soil for the nematodes present BEFORE you inoculate, add the beneficial nematodes, and then test again in a month, and then a year later.

Basically, we're asking that you fund the necessary research to determine whether this inoculum will work. We'll supply the inoculum, if you agree to pay for the testing. We need at least two months notice BEFORE we can get started, because we have to make certain we have enough nematode inoculum to add to what you want to test.

How much demand might there be for this beneficial nematode inoculum? Most people don't realize this, but there are a number of situations where beneficial nematodes need to be added to soil or to compost.

1. When nematicides have been used, those chemicals kill the beneficial nematodes as well as the pest nematodes. It is rare that the beneficials come back before the pests!

2. When pesticides are used that kill the non-target beneficial nematodes (such as 2,4-D, Bravo in some cases, anything containing an alcohol-base, dichloran, orthene, etc, etc) are used, it may be years before they return. Because it is not required that pesticides be tested to determine their effect on beneficial nematodes, some pesticides likely kill only the beneficials, and not the pest nematodes. Consumers need to demand that this information appear on pesticide labels.

3. When compost gets too hot, too anaerobic, or too wet during composting, the beneficial nematodes are either killed or forced into dormant forms. If killed, the beneficial nematodes need to be added back to the compost as soon as temperature in the pile comes back down to 100 F or lower.

Typically, if compost doesn't heat too high, the beneficial nematodes begin to grow at warm, but not-too-hot temperatures. They can then fulfill theirbeneficial roles of consuming bacteria and fungi, consuming pest nematodes if present, improving nutrient cycling in the compost, and improving aggregate structure in the compost (they are one of the engineers of larger soil pores). If they start growing rapidly enough, they can be in high numbers by the time the compost is mature and added to soil.

4. Following rapid freeze-thaw, or wet-dry cycles, pro-longed anaerobic conditions in the soil, or conditions (toxic chemical spills, fires that heat the soil to high temperatures) that kill the beneficial nematodes.

Turning to the question about compost temperature, the data we've collected shows that root-feeding nematodes don't survive thermal composting very well at all. Root-feeders appear to be quite sensitive to temperatures above 100 F, while numerous species of bacterial-feeders and fungal-feeders survive temperatures as high as 145 to 155 F. There are probably some species of root-feeding nematodes that survive high temperatures, but they don't also survive the suppressive activities of beneficial nematodes (outlined above), and the fact that there are no roots to eat in a compost pile.

A very important point with composting is if you go over 155 to 160 F, the only nematodes that survive are the ones that can produce dormant stages. This is a very limited set of nematodes and diversity suffers excessively when compost gets too high in temperature. Lack of diversity means you won't have the right beneficial nematodes to suppress, inhibit or eat the pest nematodes given all the diverse set of environmental conditions present through the course of a year. Most ecologists are very cognizant that any one particular species of organism is active and doing it's things only during a limited set of conditions. Some species require low temperature, others high, others need high humidity, others low, some like certain kinds of bacteria to eat, others find those same bacteria toxic, some like high iron, others need low, and so on. Thus, to have active beneficial nematodes through the whole year, you need as wide a diversity as you can manage. Thus, reducing that diversity by getting the compost too hot reduces the chances of having the diversity of species needed to combat the pest species.

When we might add an inoculum of beneficial nematodes to improve diversity, we aren't really certain what the best time is for adding that inoculum. In compost, beneficial nematodes appear to be happy even when the temperature is 145 F, but they were in the compost from the beginning of the heating cycle, not added to the compost. Going from ambient temperature in an inoculum to 145 F in the compost might kill the nematodes without some period of acclimation. The beneficial nematodes that were in the compost to begin with are of course acclimated to the heat. But it leaves a question about when is the best time to add an inoculum of beneficial nematodes. We need to start adding at say 100 F, and if all of the added nematodes survive that temperature, then we try adding them to the next compost at 110 F. If they all survive that, then we try 120 F, and so on.

Soil Ecology and Turf Grass Management

John Olivas, Www.Farmerssecret.com

I. What is soil ecology

The balanced interaction of soil chemical, physical, biochemical and living properties that influence consistent soil fertility and desired plant productivity.

II. Components of soil ecology

- A) Organic Fraction (c)(Not static)
  - 1) Living (bill/g, cow, 70%)(smell)
    - Microscopic plant and animal material (Beneficial-Benign-Pathogenic)
    - 1) Bacteria 2) Fungi 3) Actinomycetes
    - 4) Algae 5) Nematodes 6) Protozoa
    - 7) Viruses
  - 2) Non Living (0-5%)(color)
    - a) Anything with carbon in it.
      - Short Chain Vs. Long Chain
- B) Mineral fraction
  - Nutrient fraction - Exchangeable Vs. Fixed
  - Physical fraction - Static
- C) Water fraction
  - Quality - Salt content, NO_3
  - Quantity - Saturated Vs. Field Capacity Vs. Wilting Point
- D) Air fraction
  - Quantity - Aerobic Vs. Anaerobic

III. Reasons to adopt a healthy organic soil ecology

- A) Pest suppression
  - 1) Insect 2) Diseases
- B) Fertilizer/Water efficiency
  - 1) Reduced inputs
  - 2) Improved infiltration rates and holding capacity
  - 3) Dethatching
- C) Improved soil structure
  - 1) Chemical
    - pH, CEC, SAR, SAP
  - 2) Physical
    - Tilth, flocculation, friability
- D) Tolerance to environmental stresses
  - 1) Temperature

2) Drought
3) Manipulation (Mowing, foot traffic, compaction)

E) Sustainable approach

F) Safety

IV. Challenges to obtaining or maintaining a balanced suppressive soils
Challenges to the implementing BioTech

A) Stress factors
1) Deleterious practices favor pathogens
a) Toxic inputs
- Pesticides - Salts - Chlorine
b) Physical manipulation
- Compaction - Mechanical injury
- Level of play
c) Irrigation
- To wet = anaerobic - To dry = stress
- Quality Na - Chlorine
d) Lack of OM
e) Lack of tillage

B) Lack of Diversity (Balance)(Rain forest)
a) Pure inorganic inputs
b) Balance is the common sense approach (Calf/Chocolate/4 food)

C) Understanding
1) Knowledge of micro-biology
a) Pre/post 1940
- Didn't know - Minor nut. deff.
- Mine OM
b) Evolutionary process
- OM - Barnyard
-Suppressive soils
2) Process
a) Linear vs. non-linear (Elephant)
3) Native ecology vs. introduced
a) Recombined DNA
b) Natural
c) Native
4) Pest suppression
a) Competition, Antagonism, Predatory

V. What can you do to implement suppressive fertile soils

A) Balance
1) Mineral
a) Fertilizer (Reams' Test)
1- 7:1 Ca:Mg (4,000 lbs./A)
2- 4:1 P:K
2) Organic (fertility foundation)(bug food)(c hopkins cafe)
a) Types

1- CarbonGreat Big Plants-Soil Imunity Boosterous (c)
- Sugar (Glucose, Sucrose)
- Molasses
- Ligninite
- Algae
- Humic Acid
- Manure, Partially decomposed(compost, pasteurization)
- Cellulolytic, Lignin

2- ProteinGreat Big Plants-Soil Imunity Boosterous (c,n)
- Fish, Blood, Feather, Bone meal
- Amino Acids
- Enzymes

b) Quality
1- Carbon to Nitrogen ratio
> 30:1 = Immobilization/Assimilation
< 20:1 = Mineralization

c) Quantity (calf)
1) Consistent 2) Balanced

3) Water
1) Irrigation 2) pH
3) Leaching fraction

4) Aeration
1) O2 2) Fe

5) Reduce toxic inputs
- IPM

B) Soil Microbial Augmentation (Bio Control)
1) Competitive/Antagonism
- Manure tea (Bug Soup)
- Make your own

2) Fertility Foundation
- Mycorrhizae
- Rhizobium (Azobacter)

3) Predatory
- Hyphomycetes = Trichoderma
- Mycolytic = Bacillus subtillus

IV. Business consideration for the adoption of a balanced soil ecology
A) Desire for change (sustainability)
B) Removal of the FUD factor
1) Education (books, advisors)
2) Fundamental product attributes
a) Label b) MSDS c) QA/QC
d) Prod. Lia. Ins. e) Data f) References

C) Realities

1) No silver bullet the solution is non linear
2) Not IPM, but ITM
a) Fertility
- Inorganic -Organic
b) Pest management
-Scouting not calendar spraying

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Infinity based logic

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The Benefits to plants and soil.

What benefits are possible that make it worth paying attention to the biological side of soils in addition to the chemistry and mineral fertility? Are there any economic benefits that can make a real difference to net farm income?The answer to that question is a big YES!A spoonful of healthy soil contains many millions of beneficial microscopic organisms of various kinds that include beneficial species of bacteria, fungi, nematodes and protozoa that never cause disease or become pests. These are helpful species that perform vital "functions" in the root zone that can bring real profits to growers ***IF*** soil conditions are managed in ways that allow the microbes to live and work.

Think about the dollar potential involved with each of the following six functions and then be aware that these functions are entirely biological and ***only*** *occur through a soil foodweb that is built up, intact and working!***Decomposition of crop residues, manure and other organic material:** These materials will only decompose if certain species of fungi and bacteria, the "decomposers", decay them and allow recycling processes to occur. The ideal process forms large amounts of humus. The decay function gets rid of crop residues, but what it really does is convert the food energy in fresh organic matter to a form that feeds other soil organisms that do different indispensable functions, as described below.**Retention of nutrients:** Nitrate and some other nutrients can leach out and be lost unless they can be banked in soils until the plant needs them. The function of nutrient retention occurs when bacteria and fungi multiply and increase their populations in the soil. Bacteria and fungi are extremely rich in protein that is made from nitrogen. When bacteria and fungi multiply they gather up free nitrogen from the soil and convert it to protein in their bodies. Nitrogen in this form is a bank account of convertible nitrogen that will not leach away or be lost as a gas. Products and cultural practices that stimulate a "bloom" of bacteria or fungi reproductive growth can be used as tools to achieve nutrient retention. When this function is working in your soil you can begin to apply lower rates of N and P with no reduction in crop yield.**Nutrient Recycling:** Once nutrients have been retained, other kinds of soil organisms can be encouraged that feed on the bacteria and fungi. The rich meal of protein is metabolized and released back into the soil as ammonium that is quickly converted to nitrate for use by crops. The organisms that perform this function are beneficial nematodes that only feed on bacteria or fungi, the protozoa that feed on bacteria, and beneficial soil mites that feed on fungi. As these species go about their work they cause nitrogen especially, but also phosphorus and other nutrients, to be released at a gradual rate that supplies crops with a steady diet all season long.**Biological control of root rot and parasitic nematodes:** A healthy soil that contains a broad diversity of microbial types most often contains species that kill, inhibit or suppress the kinds of fungi that cause root rots and the kinds of nematodes that attack roots. There is plenty of research and on-farm experience to show that these economic threats can be controlled very well without the need for applied fungicides and nematicides. What it takes for this to happen is good soil health in the form of an active, intact soil foodweb.**Production of plant growth regulators:** All plants depend on the presence of certain species of soil microorganisms in the root zone to produce various hormones and other chemical "signals" that stimulate growth and development. Two plants from the same seed, one in a dead soil and the other in a living soil, both with the same nutrients, will show different rates of growth, final size and value. The plant growing in healthy soil will have found the partnership it expects with beneficial microbes that produce growth hormones not made by the plant itself. The plant in healthy soil will be the better plant.**Soil structure and tilth:** Enjoying the very best tilth depends on maintaining an aggregated or crumb soil structure. This is the ideal soil structure that allows for the optimum infiltration of air, water and roots systems. The formation of soil aggregates is mostly a biological process under the control of certain types of organisms in the soil foodweb. Aggregates will not form unless many sand, silt and clay particles are "glued" together by the gums and gels that only certain species of soil bacteria can produce. These aggregates are further strengthened against melting or collapse by certain species of beneficial fungi that grow throughout the aggregate and physically bind it. It is impossible for a soil to maintain the ideal crumb structure in the absence of the particular species of bacteria and fungi that perform the gluing and binding functions.**Clean up of herbicide or pesticide carry over:** Most herbicide and pesticide molecules can be "eaten" or degraded by certain kinds of microbes in the soil, if those species are present. A healthy soil will tend to rid itself of ag chemical carry over and other forms of pollution.***Each of the functions above describes ,how soils ate supposed to work and can work. Your opportunity is to help customers learn to employ cultural practices and biological products to get all these functions working at top capacity. Yield and profit will be the result.***

GREAT BIG PLANTS-SOIL IMUNITY BOOSTER
an experimental biofungicide
(a.k.a. GREAT BIG PLANTS-SOIL IMUNITY BOOSTER™ brand biostimulant)

Executive summary
January 6, 2003

A) Product *Type:* Viable microbial fungicide for the control and suppression of seedling diseases that has the further attributes of nematode suppression, plant bio-stimulation and Induced Systemic Resistance (SAR),

II)*Summary page*

A) *Common name:* Not applicable. The designation for this formulation is GREAT BIG PLANTS-SOIL IMUNITY BOOSTER. All reference to GREAT BIG PLANTS-SOIL IMUNITY BOOSTER are to the subject formulation. With the exception of the tradename of GREAT BIG PLANTS-SOIL IMUNITY BOOSTER™ which is the commercialized variant of this formulation.

B) *Genus and species or chemical name:* Non genetically modified, naturally occurring strains of *Bacillus subtilis*, *Paenibacillus polmyxa*, *Bacillus circulans*, and *Bacillus amyloliquefaciens.*

C) *Commodities or sites protected:* Terrestrial non-food crops athletic/recreational turf. With an initial interest in seedling diseases of vegetables, such as the minor agricultural crops: Carrot, Onion, Potato and Tomato.

D) Target pests			
	Pythium spp.	*Rhizoctonia spp.*	*Fusarium spp.*

Common names:	Damping-off seedling disease	Damping off seedling disease	Pink snow mold
	Pythium blight	Yellow patch	Fusarium blight
	Pythium root rot	Brown patch	Fusarium patch

E) *Disclosure of the formulation:*

The GREAT BIG PLANTS-SOIL IMUNITY BOOSTER is formulated as an aqueous suspension culture consisting of a consortia of ubiquitous, naturally occurring microorganisms in the *Bacillus* genera. Moreover B. subtilus, the key to GREAT BIG PLANTS-SOIL IMUNITY BOOSTER's activity is in the complementary blend of this consortia. These natural isolates were taken from soil near Pheonix, Arizona . The active agent's concentration and identity have been identified, repeatedly, by BioLog, Gas Chromatography (FAME) with Innotech, and Fatty Acid Analysis (FAA) with MicroChek.

III)*Background:*

As shown in Appendix 1, there is a volume of research to support the use of GREAT BIG PLANTS-SOIL IMUNITY BOOSTER type microorganisms for control of damping off and other root/seedling related diseases. Also, FarmersSecret.com has conducted numerous in vitro and in vivo efficacy trials on GREAT BIG PLANTS-SOIL IMUNITY BOOSTER since 1996. A summary of results are shown in tables 1 & 2 and a chronology of further testing on GREAT BIG PLANTS-SOIL IMUNITY BOOSTER over various manufacturing techniques is summarized in Appendix 2.

To a great extent, the control methods for the target plant pathogens are the use of synthetic chemical fungicides and minimally effective cultural practices. Among the largest use pesticides are Metalaxyl (Ridomil^{TM}/Subdue^{TM}), Alluminum tris (Alliette^{TM}),PCNB (Terrachlor^{TM}/Cleary=s 26^{TM}), and Benomyl (Benelate^{TM}/Fore^{TM}). Over the fact that these chemicals have toxicology issues, it has been demonstrated, by others, that each of these materials are having problems with resistance in the target pathogens. This is particularly true of these compounds is in Turf, Carrot, Onion, Potato and Tomato.

GREAT BIG PLANTS-SOIL IMUNITY BOOSTER is a mixture of naturally occurring microorganisms and is anticipated to have no or an extremely low toxicity to non-target organisms. There are few to no instances, in the literature, of these organisms having toxicity to non-target organisms.

Minimal environmental hazard fits into the

Results

Table 1. Influence of CFB on vigor and suppression of *Pythium* establishment in bent grass grown in soil-less mix infested with *Pythium*.

Treatment	Vigor[1]	% Disease ratings[2]
Nontreated control (healthy)	4.1 d	1.7 a
Pythium control	1.1 a	70.8 f
Pythium + Metalaxyl (100%)	3.3 c	34.2 de
Pythium + Benomyl (100%)	2.3 b	68.3 f
Pythium + CFB @ 15 g.p.a.	2.3 b	44.2 e
Pythium + CFB @ 30 g.p.a.	3.3 c	38.3 de

Table 2. Influence of CFB on vigor and suppression of *Rhizoctonia* establishment in bent grass grown in soil-less mix infested with *Rhizoctonia*.

Treatment	Vigor[1]	% Disease ratings[2]
Nontreated control (healthy)	4.4 e	3.3 a
Rhizoc control	1.5 a	83.3 f
Rhizoc + Metalaxyl (100%)	3.3 bc	65.8 e
Rhizoc + Benomyl (100%)	2.8 b	44.2 d
Rhizoc + CFB @ 15 g.p.a.	2.8 b	57.5 e
Rhizoc + CFB @ 30 g.p.a.	3.3 bc	45.8 d
Rhizoc + CFB @ 60 g.p.a	3.9 d	29. 2 c
Rhizoc + CFB @ 30 g.p.a + 50% metalaxyl	4.8 f	40.0 d
Rhizoc + CFB @ 30 g.p.a + 50 % benomyl	4.6 ef	18.3 b
LSD (P = 0.05)	**0.43**	**10.1**

[1]Mean of 6 replications, 1 pot per replication. Vigor was rated at 3 weeks after pathogen infestation on a 1-5 scale (1 = poor growth, 2 = better, 3 = good, 4 = very good, 5 = excellent)
[2]Mean of 6 replications. Disease was assessed 4 weeks after pathogen infestation on a 1-5 scale (1 = 0-20% disease, 2 = 20-40%, 3 = 40 -60%, 4 = 60-80%, 5 = 80-100%).

overall strategy of EPA registration by being the basis for a minimum level of toxicology testing. It is anticipated that results showing minimal to no toxicity will be the basis for which to ask for waivers of further Tier I, II, and III toxicological testing. Preliminary testing will identify further crop/market options, Treatment/plGreat Big Plants-Soil Imunity Boosterment options and PPE requirements.

Fig. 3. Healthy stand of Geranium grown in *Pythium* and *Rhizoctonia* infested soil-less media 6 weeks after seeding

CFB **Control**

VII) *Potential benefits:*

Economic – FarmersSecret.com's GREAT BIG PLANTS-SOIL IMUNITY BOOSTER offers a superior (See table 1&2 for activity over current chemical alternatives) and potentially safer method of controlling damping off diseases than currently available chemicals fungicides. Our preliminary results suggests that, not only, is GREAT BIG PLANTS-SOIL IMUNITY BOOSTER more efficacious in pathogen control than the synthetic chemical products, but also consistently results in more vigorous plant growth via a bio-stimulation effect through a Induced Systemic Resistance (ISR) effect (Figs. 1, 2 & 3). Further, it has been demonstrated by major university testing, (Tables 1 & 2) that GREAT BIG PLANTS-SOIL IMUNITY BOOSTER could be used with lower rates of the chemical fungicides, and still obtain better results. This would allow for less total tons of chemical to be applied annually. Based on a current comparative analysis, FarmersSecret.com anticipates commercializing GREAT BIG PLANTS-SOIL IMUNITY BOOSTER in a manner that also lowers user costs in comparison to chemical treatments.

The target pathogens appear in all parts of the United States and plague not only turf and ornamental but many minor/major crops as well. The market for efficacious, economical, natural, non-chemical products continues to grow prompted by grower concerns, public demand, and interest by academia.

Environmental - It is anticipated that GREAT BIG PLANTS-SOIL IMUNITY BOOSTER will offer a safer and more efficacious alternative than chemicals. GREAT BIG PLANTS-SOIL IMUNITY BOOSTER is compatible with most sustainable and less toxic chemical products and can be introduced in conjunction with current cultural practices. Further, this renewable technology supports Integrated Pest Management and allows for immediate reduction of the application of harsher chemical alternatives as well as a potential cost savings.

VIII) *Commercialization:*

Registration – Proposed further research is specifically focused on partially satisfying 40 CFR 158.740 - Microbial Pesticide Data Requirements as published by the EPA Office of Pesticide Programs. Further research efforts will be plGreat Big Plants-Soil Imunity Boosterd in expanding the understanding of the mode of action and purification/concentration of active ingredients.

Commercialization - The results from the ongoing studies will provide Www.Farmerssecret.com with the basic data to initiate commercialization, product registration, and expanded label claims for minor/major crop use. Efficacy results will warrant further expanded investigation of the end uses on food crops. The current proposed study results will also help FarmersSecret.com to develop Product Label, MSDS and product handling and use instructions.

Appendix 1

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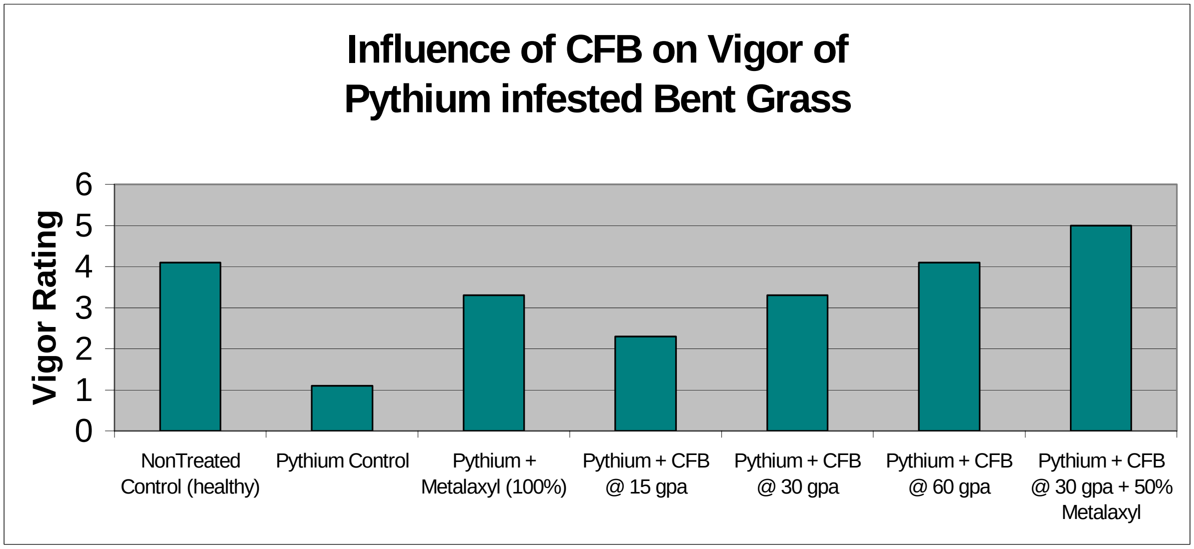

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Appendix 2

Chronology of efficacy data for GREAT BIG PLANTS-SOIL IMUNITY BOOSTER (a.k.a. GREAT BIG PLANTS-SOIL IMUNITY BOOSTER) based on increased concentration of active agents with improvements in Quality Control/Quality Assurance and manufacturing technique:

A) GREAT BIG PLANTS-SOIL IMUNITY BOOSTER at 10^2 yield-

-By Cornell University

1) The presence of endo and exochitinase

2) In vitro control of

a) Pythium, 33% control b) Rhizoctonia, 45% control c) Trichoderma, 52% control

B) 10^4 yield-

- Evaluation of GREAT BIG PLANTS-SOIL IMUNITY BOOSTER by FarmersSecret.com in a bench study mosquito larvae showed:

1) 100% GREAT BIG PLANTS-SOIL IMUNITY BOOSTER caused total mortality

2) 50% GREAT BIG PLANTS-SOIL IMUNITY BOOSTER 50% Water caused the larvae not to respond external stimulus.

3) 100% Water larvae remained active.

- Field evaluation of GREAT BIG PLANTS-SOIL IMUNITY BOOSTER in a replicated study showed:

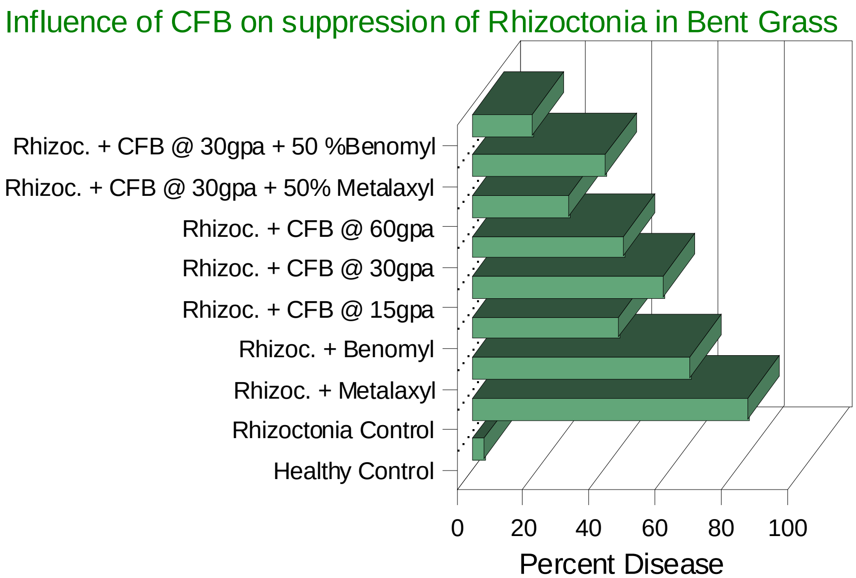
1) Reduction in Nematode/Pythium damage over control and Trichoderma inoculum.

2) Support of Mycorrhizal inoculum

3) Allowance of lower fumigation rates

- Field evaluation of GREAT BIG PLANTS-SOIL IMUNITY BOOSTER on an non-replicated commercial scale showed:

1) Elimination of nematode populations in the treated area.



C) 10^4 to 10^6

- In vitro testing

1) University of Arizona

- Test 1 gave 100% control at a 50% dilution. As little as 10% dilution gave 60% control against Phytophthora.

- Test 2 gave 100% control at a 50% dilution. As little as 10% dilution gave 75% control against Pythiu

- Test 3 - A screening study gave 100% control of *P. aphanidermatum* in 2 days, *P. capsici* in 3 days, *parasitica*

in 3 days, *P. ultimum* in 2 days with good levels of suppression with lower dilutions.

- Test 4 Exposure time vs. 75 % concentration yielded 80% control in two hours and 100% control in 6 days.

2) BBC Laboratories (7/96), Minimum does dilution ratios for Pythium

Dilu.	Strong inhibition	Partial inhibition	No inhibition.
1:0	6 of 12	6 of 12	0

1:2	8 of 12	4 of 12	0
1:3	11 of 12	1 of 12	0
1:5	6 of 12	1 of 12	5 of 12
1:10	3 of 12	2 of 12	7 of 12

3) BBC Laboratories (1/97), Pythium species specific efficacy

P. ultimum = Partial inhibition in 33% of trials

P. cactorum = Partial inhibition in 33% of trials

4) Identification of active organisms.

- Field Testing

1) Auburn University (9/97)

- Pythium control in turf grass vs. rates

a)7.5 Great Big Plantsa = 1000 CFU/gdw

b) 15 Great Big Plantsa = 100 CFU/gdw

c) 30 Great Big Plantsa = 0 CFU/gdw- Identified Pythium as *P. carolinianum*

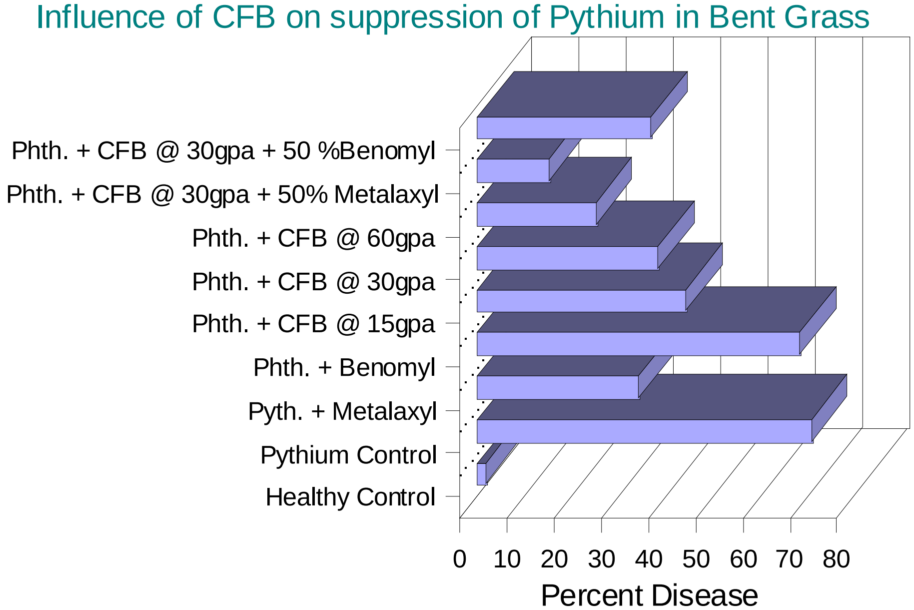
2) AG Sod farm

- Pythium control in turf grass vs. rates

a) 0 Great Big Plantsa = 10CFU/gdw

b) 30 Great Big Plantsa = CFU/gdw

Influence of CFB on suppression of Pythium in Bent Grass



3) Auburn University Turf (3/99)

Tested control of Pythium and Rhizoctonia Vs. registered chemical summarized at left and above.

C) 10^4 to 10^6 Continued

- Grower testing – Bolthouse 2001

- Grower testing – Bolthouse 2001

Disease reduction and yield improvement with GREAT BIG PLANTS-SOIL IMUNITY BOOSTER F

Bolthouse Farms
Jun 18, 2001
Results of Hand Harvest

Estimated yield per acre in Tons

Treatment	Marketable	Stub,Fork,Split
Great Big Plants-Soil Imunity Booster 60 Great Big Plantsa No Ridomil	29.68	1.85
Great Big Plants-Soil Imunity Booster 30 Great Big Plantsa Ridomil	36.10	1.12
Ridomil	19.74	4.25

Estimated yield/quality improvement over Ridomil

Treatment	% Gain Marketable	% Reduction Cull
Great Big Plants-Soil Imunity Booster 60 Great Big Plantsa No Ridomil	50.34	-56.41

Diseased Ridomil only treatment: Entire harvest of Stubbed, forked, split from 5 ft of row.

Great Big Plants-Soil Imunity Booster 30 Great Big Plantsa Ridomil	82.90	-73.72
Ridomil	0.00	0.00

Commercial Harvest data (8/20/01):

Treatment	% Packout	% Jumbo	Tons
Great Big Plants-Soil Imunity Booster 60 Great Big Plantsa No Ridomil	56.00%	23.00%	34.7
Great Big Plants-Soil Imunity Booster 30 Great Big Plantsa Ridomil	57.00%	13.00%	31.1
Ridomil	53.00%	11.00%	31.1

Diseased Ridomil and Ace treatment: Entire harvest of Stubbed, forked, split from 5 ft of row.

- Grower testing – Bolthouse 2002

2nd year study: Disease reduction and yield improvement with GREAT BIG PLANTS-SOIL IMUNITY BOOSTE
Results of Hand Harvest from Rosscamp

Variety: ? Field: ?
Sample date: Oct 22, 2002 Bucket tare: 8.5 oz.
Est. harvest date: Nov. 1
Sample Area: 3 linear feet of 40 inch beds. Acreage: 0.000229568
Replicates: 3

Treated area: 9 lines of 12 (40") rows by 2323 feet = 19.2 acres
Treatment rate: 180 gallons divided by 19.2 acres on a 20 inch band = 18.75 gal/treated acre
Treatment method: 20" band over the top with sprinkler incorporation

Ridomil rates: Both treatments received 16 oz. (8 oz on 8/3, 4 oz on 8/22, 4 oz. On 9/16)

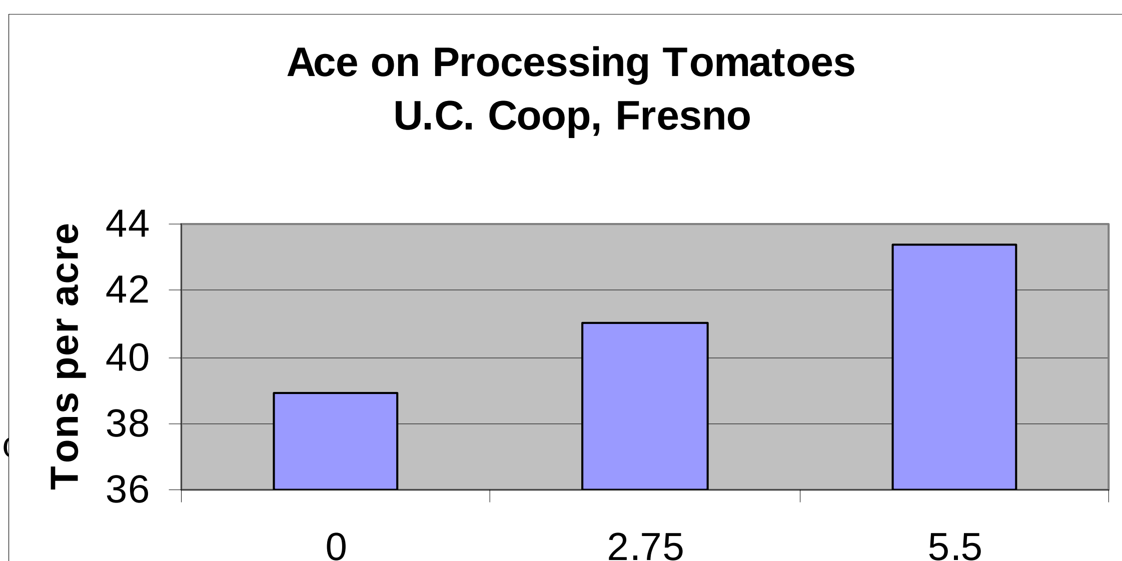
Comment on sample method: All carrots were collected from each replicate including those that would not normally market through the harvester belts to ascertain disease. This will exaggerate total tonnage. Also, the Ridomil only treatments had more stunting which will greatly reduce commercial harvest tonnage.

Ave Oz.:	Jumbo	Marketable	Stub, Fork
Great Big Plants-Soil Imunity Booster	27.8333	199.8333	5.500000
Ridomil	3.33333	184.1667	2.000000

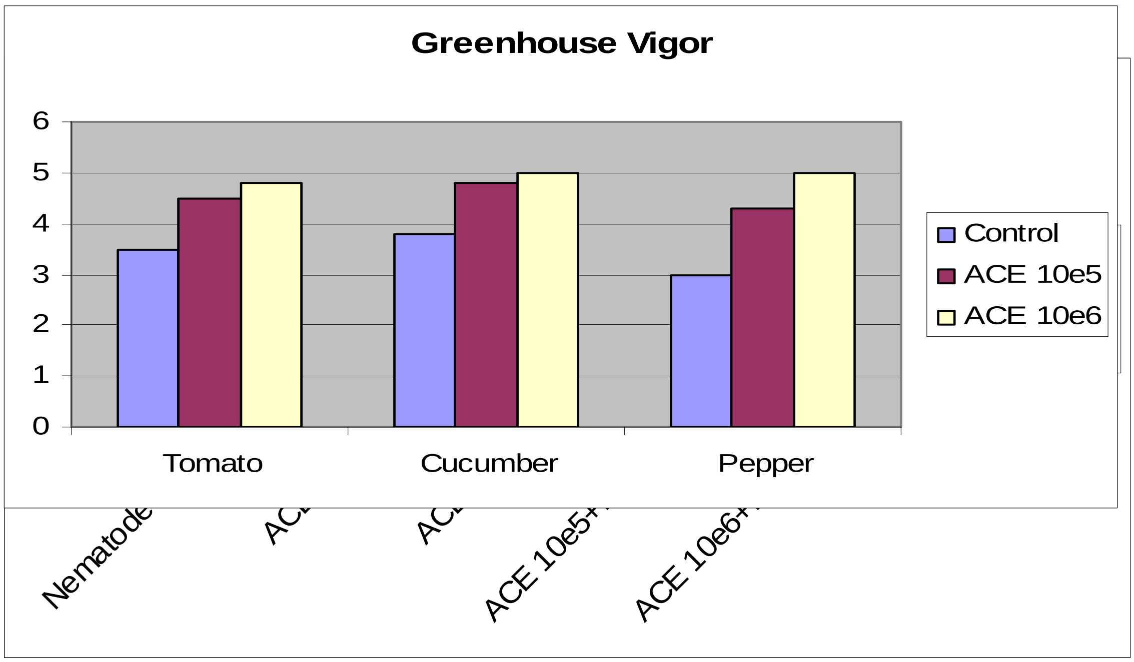
In Oz.

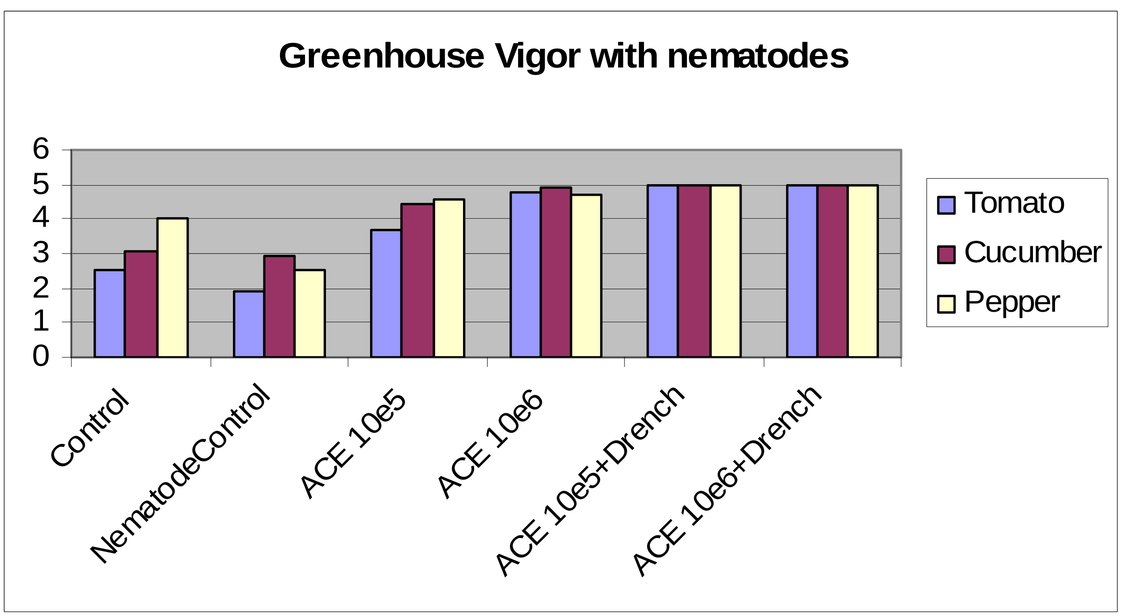
Treatment	Rep 1 Jumbo	Marketable	Stub,Fork,Split	Rep 2 Jumbo	Marketable	Stub,Fork,Split	Rep 3 Jumbo	Marketable	Stub,Fork,S
Great Big Plants-Soil Imunity Booster	24.5	199.5	4.5	43.5	192.5	10.5	15.5	207.5	1.5
Ridomil	6.5	186.5	0.5	3.5	181.5	3.5	0	184.5	2

- Field Testing Continued
  - UC Davis – WestSide field station, Don May – 2000



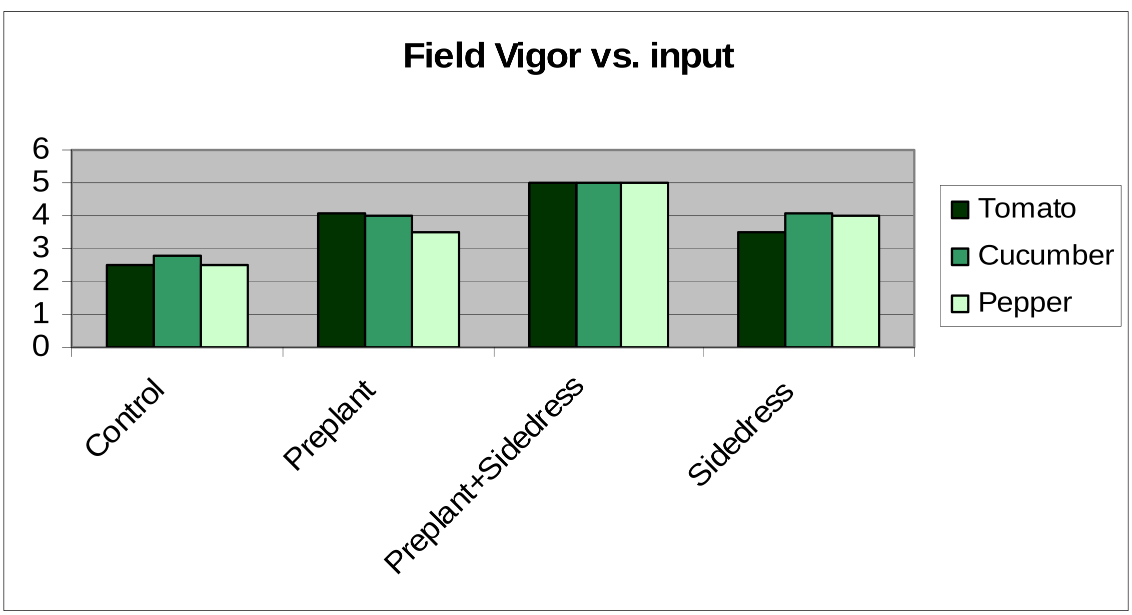
- University Testing – USDA IR-4 – 2002
    - Greenhouse Vigor and Nematode Control

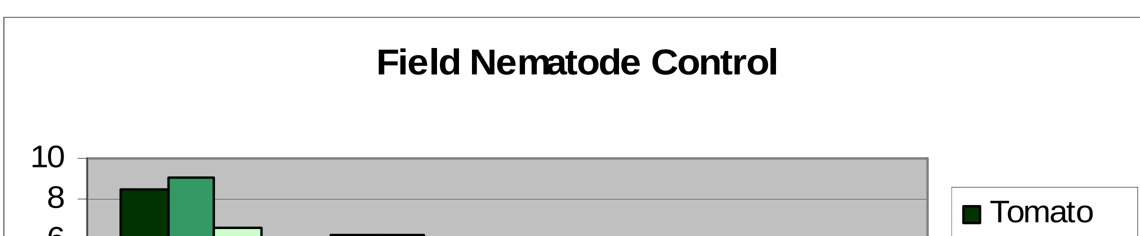




- Greenhouse photos

- Field Vigor and Nematode Control Vs. Treatment option





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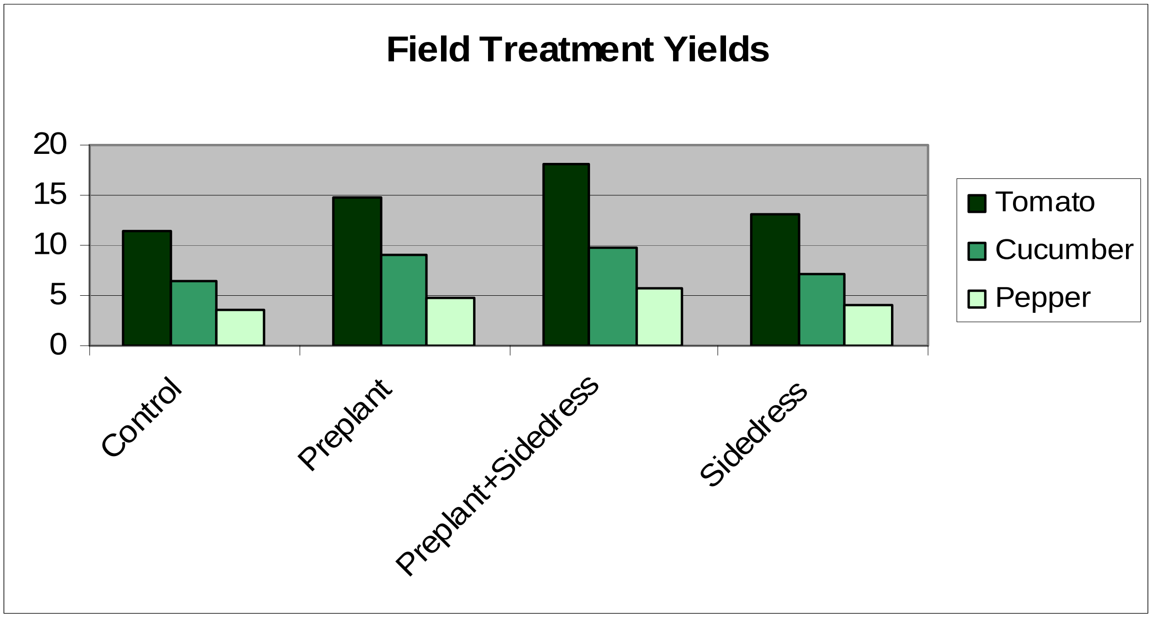
Field Treatment Yields
20
15
10
5
0
Control
Preplant
Preplant+Sidedress
Sidedress
Tomato
Cucumber
Pepper