

Organic Gardening & Landscaping

Realities, Science and Myths

Killingworth Evergreen Garden Club

Joe Magazzi

President & Co-Founder

The **SCIENCE** of Organic Plant, Tree & Turf Care



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With Special Guest

Ian Gibson, Owner & Grower
Wellstone Farm



Outline

I. What is Organic? Definition and Regulations

II. The Science of Organic Input Strategies

a) Soil Health Through Fertility & Biology

b) Organic Disease Control – Fungi & Bacteria

c) Organic Pest Control - Insect, Grub, Tick

d) Organic Weed Control

III. Organic Myths

IV. How To Grow Organically In A Few Easy Steps





The History of Organic Plant, Tree & Turf Care



History of Organic Farming

- *1939-1945 (WW II)*: During the war, the U.S. government built 10 new plants to supply nitrogen for bombs. After the war, those plants were converted to produce ammonia for fertilizer. Nerve gas agents used in the war were found to kill insects. Herbicide research for biological weapon use by the US and UK led to the discovery of 2,4-D.
- *1940s*: J.I. Rodale, considered the pioneer of organic agriculture, began to study the link between healthy soil, healthy food and healthy people. Rodale theorized that to preserve and improve our health we must restore and protect the natural health of the soil.
- *1947*: Rodale started the Rodale Institute; still the leading research institution in organic research and education.
- *1985*: Congress adds funds for organic agriculture in the Farm Bill.
- *1990*: Congress passed the Organic Foods Production Act (OFPA) to develop a national standard for organic food and fiber production.
- *2002*: Final written rules were implemented in the fall of that year.



What does “Organic” Mean?

Organic: Any compound that contains a carbon atom(s).



Organic Growing: “Organic (agriculture) is an ecological production management system that promotes and enhances biodiversity, biological cycles and soil biological activity. It is based on minimal use of off-farm inputs and on management practices that restore, maintain and enhance ecological harmony”...USDA



Watch for labels that have “Organic” on them because they contain carbon; also watch for “Contains Organic Ingredients” & “All Natural”



Organic Standards and Regulations

Organic practices produce products using methods that preserve the environment and avoid most synthetic materials such as pesticides and antibiotics.

Organic growers and processors:

- Preserve natural resources and biodiversity.
- Support animal health and welfare.
- Provide access to the outdoors so that animals can exercise their natural behaviors.
- Do not use genetically modified ingredients (GMOs).
- Only use approved materials.
- Receive annual onsite inspections.
- Separate organic food from non-organic food.



Organic Product Certification

- The Organic Materials Review Institute (OMRI), The Washington State Department of Agriculture (WSDA) and smaller, local agencies such as BayState Organic Certifiers are organizations that determine which input products are allowed for use in organic production and processing.
- Certifying agencies support organic integrity by providing an independent review of products intended for use in certified organic production, handling, and processing.
- When companies apply, these agencies review their products against the organic standards. Acceptable products are Listed.
- Listed products are allowed for use in certified organic operations under the USDA National Organic Program.



Integrated Pest Management (IPM)

“Integrated Pest Management (IPM) is an effective and environmentally sensitive approach to pest management that relies on a combination of common-sense practices. IPM programs use information on the life cycles of insects to manage pest damage by the most economical means, and with the least possible hazard to people, property, and the environment. The IPM approach can be applied to both agricultural and non-agricultural settings, such as the home, garden, and workplace”...*EPA.gov*

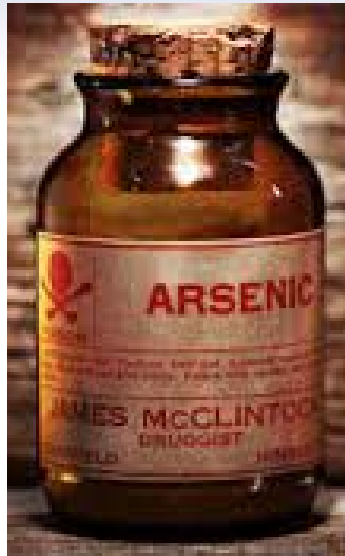
4 Tiered IPM Approach:

1. *Set Action Thresholds* - The point at which control action must be taken.
2. *Monitor and Identify Pests* - Monitor for pests to ID them accurately.
3. *Prevention* – Crop rotation, pest-resistant varieties, pest-free rootstock.
4. *Control* - Use less risky, targeted controls first; try to avoid broadcasts.

Organic practices apply many of the same concepts as IPM but limits the use of pesticides to those that are produced from natural sources as opposed to the synthetic chemicals allowed under IPM.



Organic Doesn't Always = Safe!



ScienceDaily®

Your source for the latest research news

Featured Research

from universities, journals, and other organizations

Organic agriculture can pollute groundwater, research shows

Date: February 18, 2014

Source: American Associates, Ben-Gurion University of the Negev

PubMed.gov

PubMed

US National Library of Medicine
National Institutes of Health

Advanced

Environ Sci Pollut Res Int. 2013 Mar;20(3):1574-85. doi: 10.1007/s11356-012-1114-7. Epub 2012 Aug 14.

Effects of copper fungicide residues on the microbial function of vineyard soils.

Wightwick AM¹, Salzman SA, Reichman SM, Allinson G, Menzies NW.

Author information

¹School of Agriculture and Food Sciences, The University of Queensland, St Lucia, Queensland, 4072, Australia.

NCBI Resources How To

PubMed.gov

US National Library of Medicine
National Institutes of Health

PubMed

Advanced

Pest Manag Sci. 2012 Dec;68(12):1523-36. doi: 10.1002/ps.3396. Epub 2012 Oct 29.

The non-target impact of spinosyns on beneficial arthropods.

Biondi A¹, Mommaerts V, Smagghe G, Viñuela E, Zappalà L, Desneux N.

Author information

¹French National Institute for Agricultural Research (INRA), ISA, Sophia-Antipolis,

theguardian

News US World Sports Comment Culture Business M

News Science Medical research

Man dies after inhaling fungal spores from garden compost

- Common mould can harm lungs, scientists warn
- An 'occupational hazard' for gardeners, but risk low

Organic Input Options:

Soil Health Through Fertility



How To Grow Organically: Soil Testing

**IT'S THE SOIL TEST,
STUPID**



How To Grow Organically: Soil Testing

Strong Acid: This type of extract can test the total amount of nutrients in the soil and compute Base Saturation and Cation Exchange Capacity. The amount of nutrients dissolved by strong acids is not the same amount made available by the weak acids in the exudates given off by the plant roots.

What's in the soil, not what's plant available.

No Acid (Paste Test): Uses deionized water to extract nutrients. The rhizosphere (root zone) is slightly acidic. Only beneficial for hydroponics (soilless) medias.

Weak Acid:* Plant exudates are weak carbonic acids that will extract more nutrients from the soil than just water. It is called the Morgan Extract. The Morgan extract is a "universal" extractant, meaning all major nutrients (including phosphorus) and many micronutrients can all be measured in the one extract. Dr. M.F. Morgan developed the Morgan extract in the 1930's and 40's at the University of Connecticut.

***What is plant available. Suggested test for New England Soils!**



How To Grow Organically: Soil Testing

Soil Report				
Job Name	Stone Hill River Farms		Date	5/2/2014
Company	Stone Hill River Farms		Submitted By	
Sample Location	Garden	Mulch		
Sample ID	Soil			
Lab Number	1	2		
Sample Depth in inches	6	6		
Total Exchange Capacity (M. E.)	8.81	10.53		
pH of Soil Sample	7.5	7.2		
Organic Matter, Percent	19.72	38.21		
ANIONS	SULFUR:	p.p.m.	22	22
	Mehlich III Phosphorous:	as (P ₂ O ₅) lbs / acre	975	1363
EXCHANGEABLE CATIONS	CALCIUM:	Desired Value lbs / acre	2397	2863
		Value Found	1059	1478
		Deficit	-1338	-1385
	MAGNESIUM:	Desired Value lbs / acre	253	303
	Value Found	728	736	
	Deficit			
	POTASSIUM:	Desired Value lbs / acre	274	328
		Value Found	1846	2214
		Deficit		
	SODIUM:	lbs / acre	193	223
BASE SATURATION %	Calcium (60 to 70%)		30.04	35.10
	Magnesium (10 to 20%)		34.42	29.13
	Potassium (2 to 5%)		26.85	26.96
	Sodium (.5 to 3%)		4.77	4.61
	Other Bases (Variable)		3.90	4.20
	Exchangable Hydrogen (10 to 15%)		0.00	0.00
TRACE ELEMENTS	Boron (p.p.m.)		0.63	0.61
	Iron (p.p.m.)		145	147
	Manganese (p.p.m.)		24	30
	Copper (p.p.m.)		0.95	0.95
	Zinc (p.p.m.)		8.78	8.44
	Aluminum (p.p.m.)		178	264
OTHER	NH4-N (p.p.m.)		0.21	0.2
	N03-N (p.p.m.)		27.3	99.9

Components of a complete soil test:

- *Nutrients*: Macro (N, P, K) and Micro.
- *pH* – Measures the acidity or alkalinity of the soil.
- *Organic Matter* – “organics” or carbon in soil. Indicates water and nutrient holding capacity and buffering ability.
- *Cation Exchange Capacity (CEC)* – the total amount of exchangeable cations (plant available) that the soil can adsorb (Ca, Mg, K, Fe etc...). Affected by organics, clay and pH.
- *Percent Saturation*: Estimate of the percent of the soil CEC that is occupied by a particular nutrient (nutrient saturation). Estimates “too much or too little”.

How To Grow Organically: Soil Testing



Free

<http://www.ct.gov/caes/cwp/view.asp?a=2336&q=378202>



\$8 / \$15

<http://www.soiltest.uconn.edu/sampling.php>

<https://soiltest.umass.edu/ordering-information>



\$25

<http://www.loganlabs.com/testing-services.ht>

Organic Fertilizers & Amendments

Organic Nutrient	Value
Granulars	Mixture of various organics (Soy, Feather Meal, Soybean Meal, Cottonseed Meal, Alfalfa Meal, Meat & Bone Meal, Blood Meal, Corn Solubles)
Fish	Nitrogen, phosphorus. Multiple Micros. Carbon.
Seaweed	Many micros. Growth factors. Carbon.
Humates	Carbon! Micronutrients.
Molasses	Micronutrients. Carbon.
Compost	Micronutrients. Watch for Burn or inconsistency.
Worm Castings	Micronutrients. Watch for Burn or inconsistency.
Manures	Nitrogen. Micronutrients. Carbon.
Borax	Boron.
Epsom Salts	Magnesium.



Organic Nutrients: Not Always Safe!!!!



**Fertilizers and Pesticides, *Synthetic or Organic*, can be harmful.
Apply "IPM" principles to nutrient programs to minimize or eliminate!**



Organic Input Options:

Soil Health Through Soil Biology



Science News

... from universities, journals, and other research organizations

Save Email Print Share

Report Proposes Microbiology's Grand Challenge to Help Feed the World

Aug. 27, 2013 — A greater focus on the role of microbiology in agriculture combined with new technologies can help mitigate potential food shortages associated with world population increases according to a new report from the American Academy of Microbiology.

Related Topics

Plants & Animals

- ▶ Endangered Plants
- ▶ Agriculture and Food
- ▶ Microbes and More

Articles

- ▶ Humus
- ▶ Microorganism
- ▶ Organic farming

Soil Biodiversity Will Be Crucial to Future Land Management and Response to Climate Change

Aug. 12, 2013 — Research by scientists at The University of Manchester and Lancaster shows maintaining healthy soil biodiversity can play an important role in optimising land management programmes to reap benefits from the living soil. The findings, published in the latest edition of the journal *PNAS*, extend the understanding about the factors that regulate soil biodiversity.

Related Topics

Plants & Animals

- ▶ Soil Types
- ▶ Organic
- ▶ Fungus

Earth & Climate

- ▶ Landslides

Articles

- ▶ Humus
- ▶ Soil science
- ▶ Infiltration
- ▶ Agronomy
- ▶ Soil life

Bacteria Enhance Growth of Fruit Trees Up to 40 Percent

Sep. 11, 2013 — Improvement in reforestation and agriculture is possible thanks to the work of scientists in the Center of Research and Advanced Studies (Cinvestav) who use different strains of fungi and bacteria to promote development and health in trees, which have enabled them to accelerate growth of different species up to 40 percent.

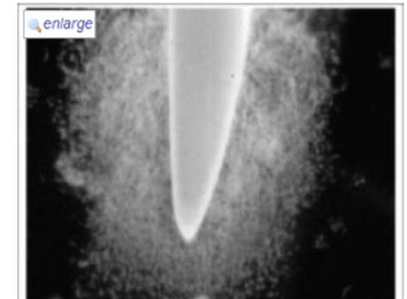


Share This:

According to researcher Victor Olalde Portugal, responsible of the project, one

The Secret Life of Underground Microbes: Plant Root Microbiomes Rule the World

Sep. 18, 2013 — We often ignore what we cannot see, and yet organisms below the soil's surface play a vital role in plant functions and ecosystem well-being. These microbes can influence a plant's genetic structure, its health, and its interactions with other plants. A new series of articles in a Special Section in the *American Journal of Botany* on Rhizosphere Interactions: The Root Microbiome explores how root microbiomes influence plants across multiple scales -- from cellular, bacterial, and whole plant levels to community and ecosystem



Research on the benefits of using soil microbiology in growing practices is absolutely exploding right now!



The Relationship of Plants & Microorganisms

What is soil and how do we supplement it?

Minerals & Nutrients



Water



Gas



Organic Matter & Microbes



Traditional growing practices largely ignore supplementing biology in the soil. Many chemicals that are used are in fact detrimental to microbes.



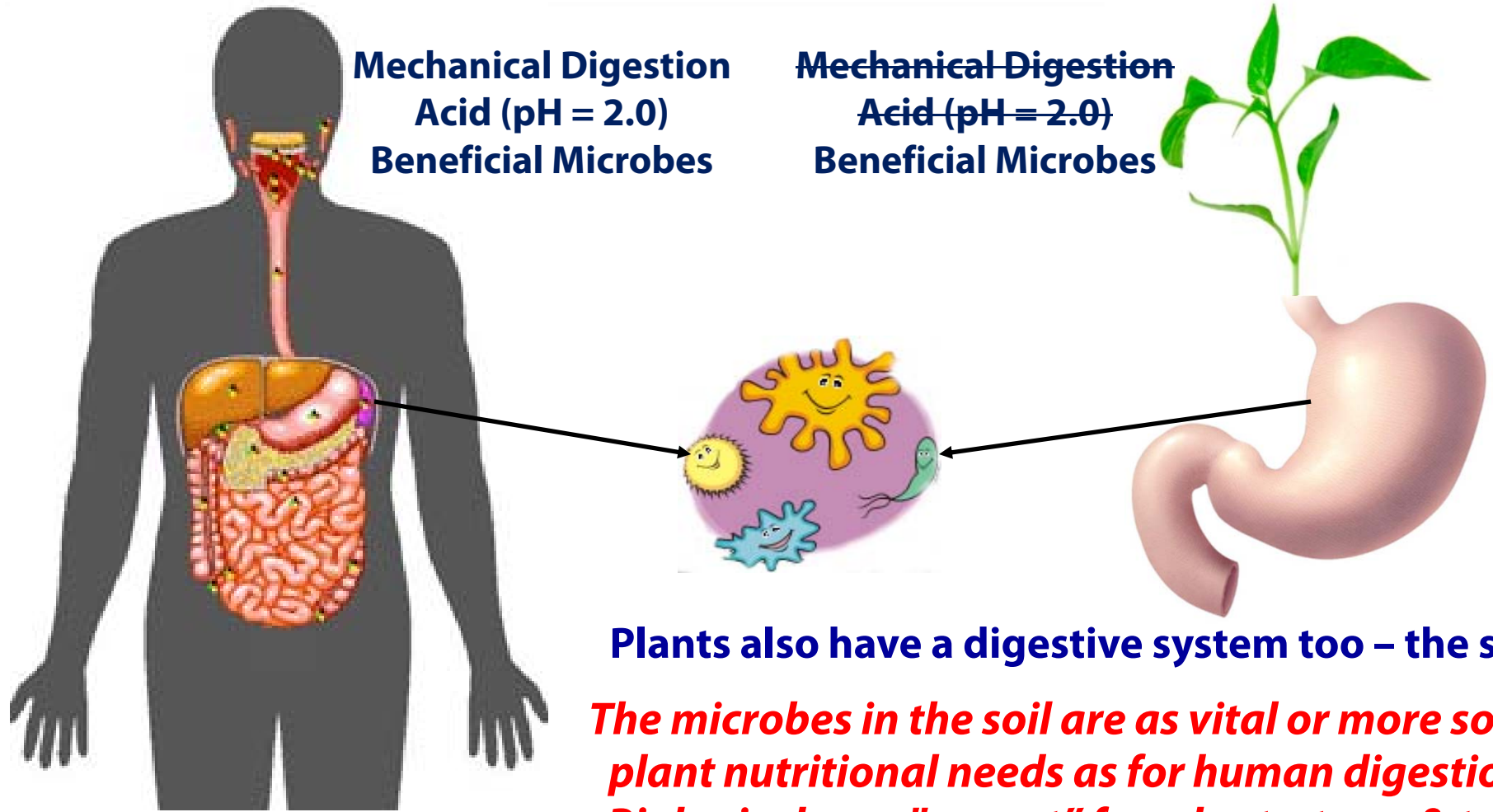
The Relationship of Plants & Microorganisms



We all know the benefits of probiotics for human health and digestion...



The Relationship of Plants & Microorganisms



Plants also have a digestive system too – the soil.

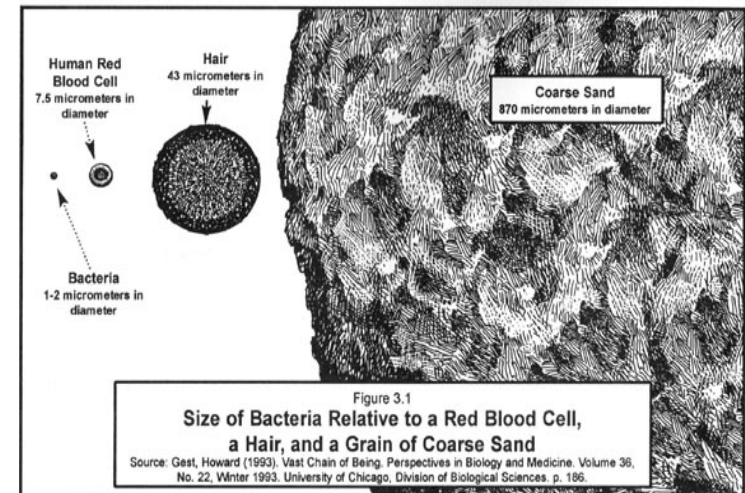
The microbes in the soil are as vital or more so for plant nutritional needs as for human digestion. Biologicals are "yogurt" for plants, trees & turf!



The Relationship of Plants & Microorganisms

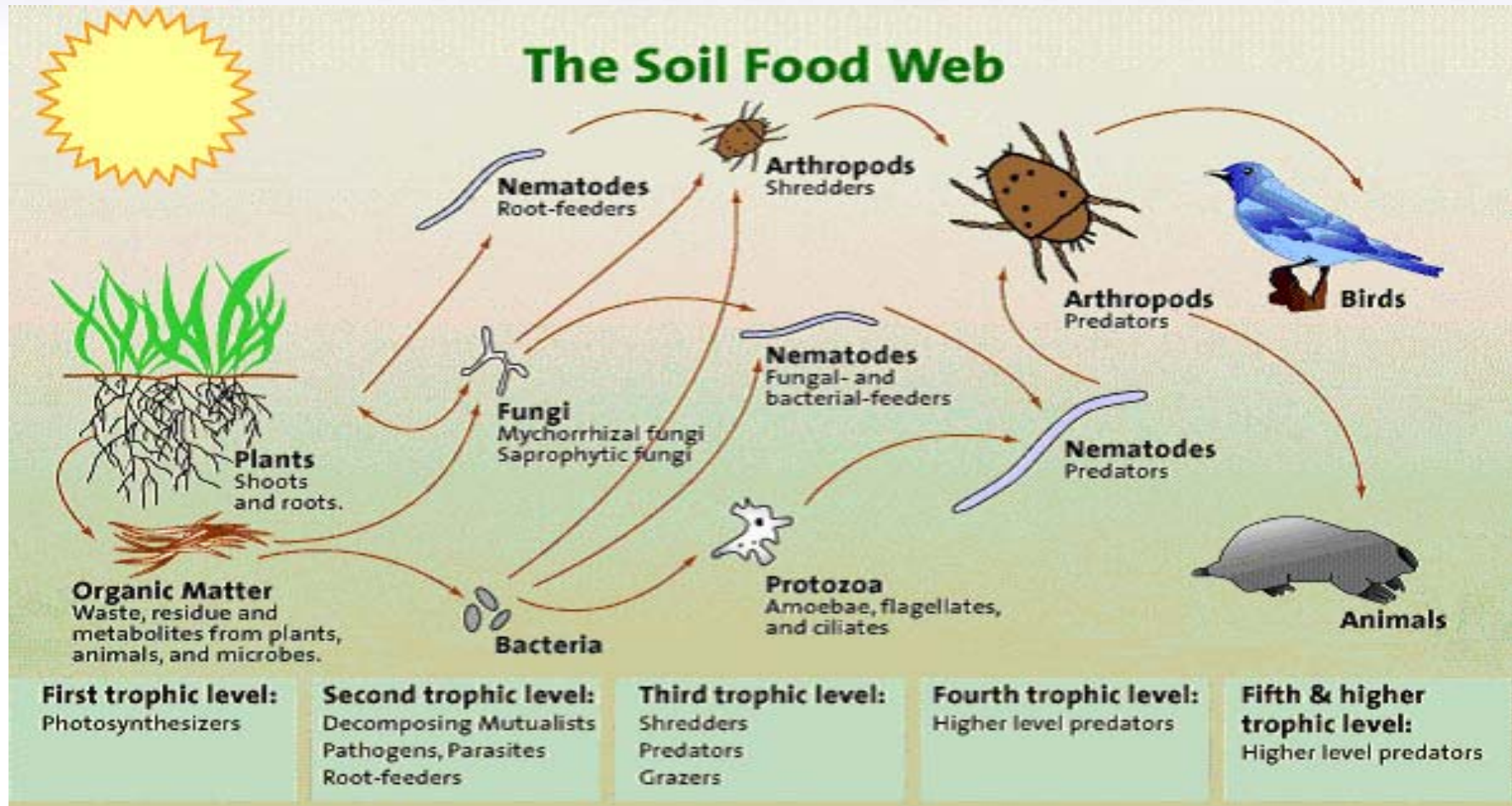
Facts about soil microorganisms:

- 1 gram of soil contains:
 - 1 million (1×10^6) fungi.
 - 1 billion (1×10^9) bacteria.
- 1 ton of bacteria per acre (2 cows).
- Between 4,000 to 10,000 species of bacteria in a gram of soil.
- Estimates are that there are between 1 million and 100 million species of bacteria; only 0.5% to 0.005% are likely described in detail.
- 90%-95% of the cells on or in the human body are bacteria.



The Relationship of Plants & Microorganisms

Building the Soil Food Web



Build your soil *from the bottom up* with *bacteria and fungi* to help reduce disease, fertilizer and pesticide use, costs and maintenance.

Organic Disease Control

- Fungal and Bacterial



Probiotics As A Tool: Disease Control

**“The Enemy of My
Enemy is My Friend”**



Probiotics As A Tool: Disease Control

Mechanism #1 – Microbes Produce Compounds That Target Pathogens

J Microbiol Biotechnol. 2008 Apr;18(4):682-5.

Inhibitory effect against Akt of cyclic dipeptides isolated from *Bacillus* sp.

Hong S, Moon BH, Yong Y, Shin SY, Lee YH, Lim Y.

Bio/Molecular Informatics Center, Division of Bioscience and Biotechnology, Konkuk University, Seoul 143-701, Korea.

Abstract

Among thirteen strains of the genus *Bacillus* isolated from Shrimp-jeotkal in our laboratory, a strain BA34 showing good antifungal activity against *Phytophthora infestans* in a previous experiment was tested for the inhibitory effect against Akt, protein kinase B. Since Akt is known to play an important role in controlling apoptosis, its inhibitors can be used as potential apoptosis-inducing agents in the treatment of cancer. Two active compounds were isolated and their structures were determined. They have similar structures, despite showing different inhibitory effects. In order to elucidate the reasons for these different effects, three-dimensional studies were carried out.

PMID: 18467861 [PubMed - indexed for MEDLINE] [Free Article](#)

Prikl Biokhim Mikrobiol. 2005 Sep-Oct;41(5):553-7.

[*Bacillus subtilis* and phenotypically similar strains producing hexaene antibiotics]

[Article in Russian]

Kudriashova EB, Vinokurova NG, Ariskina EV.

Abstract

We studied metabolites synthesized by *Bacillus subtilis* strains, including the type strain of *B. atrophaeus* and phenotypically similar cultures. These metabolites were presented by polyene antibiotics with conjugated double bonds. Hexaenes from study strains inhibited the growth of phytopathogenic fungi *Fusarium culmorum*, *F. sporotrichiella*, *F. oxysporum*, *Botrytis sorokiniana*, *Alternaria tenuis*, and *Phytophthora infestans*. The degree of growth inhibition depended on the test fungus.

PMID: 16240655 [PubMed - indexed for MEDLINE]

Beneficial microbes produce compounds that can directly kill pathogens.

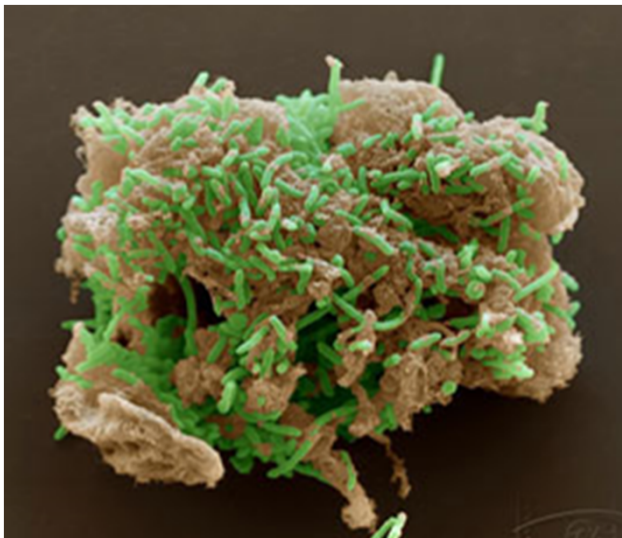


Probiotics As A Tool: Disease Control

Mechanism #2 – Numbers Game, Beneficials Out-Compete Pathogens

Competitive Exclusion Principle (Gause's Law)

“two species competing for the same resources cannot stably coexist if other ecological factors are constant. One of the two competitors will always overcome the other, leading to either the extinction of this competitor or an evolutionary or behavioral shift towards a different ecological niche. The principle has been paraphrased into the maxim "complete competitors cannot coexist".”



- Bacteria and fungi compete for the same resources.
- Bacteria divide much faster than fungi and can out-compete them for limited resources.
- Can a lone coyote establish territory where there is already 100 wolves?



Probiotics As A Tool: Disease Control

Mechanism #3 – Healthier Plants Naturally Resist Pests & Pathogens

Trophobiosis Theory: A Pest Starves on a Healthy Plant

By John Paull

Fenner School of Environment & Society, Australian National University, Canberra

Pests shun healthy plants. Pesticides weaken plants. Weakened plants open the door to pests and disease. Hence pesticides precipitate pest attack and disease susceptibility, and thus they induce a cycle of further pesticide use.

The theory of trophobiosis in pest and disease control

Maria José Guazzelli, Laércio Meirelles, Ricardo Barreto, André Gonçalves, Cristiano Motter and Luis Carlos Rupp



Farmers meet often to exchange information and experiences with bio-fertilizers.

Pathogens evolved eating dead or weakened plant material with simple amino acids and sugars.
Healthy plants contain proteins and complex sugars that can not be digested by pests.

Probiotics As A Tool: Disease Control

The screenshot shows the Science journal website interface. At the top, there is a navigation bar with "Science" in a large font, followed by "AAAAS.ORG", "FEEDBACK", "HELP", "LIBRARIANS", and "Science Magazine". Below this is a search bar and links for "GUEST", "ALERTS", and "ACCESS R". A red banner below the navigation bar reads "Science The World's Leading Journal of Original Scientific Research, Global News, and Commentary." Below the banner is a menu with "Science Home", "Current Issue", "Previous Issues", "Science Express", "Science Products", "My Science", and "About the Journal". The main content area shows the article details for "Science 27 May 2011: Vol. 332 no. 6033 pp. 1097-1100 DOI: 10.1126/science.1203980". The article title is "Deciphering the Rhizosphere Microbiome for Disease-Suppressive Bacteria". The authors listed are Rodrigo Mendes^{1,†}, Marco Kruijt^{1,†,‡}, Irene de Bruijn^{1,§}, Ester Dekkers¹, Menno van der Voort¹, Johannes H. M. Schneider², Yvette M. Piceno³, Todd Z. DeSantis^{3,4}, Gary L. Andersen³, Peter A. H. M. Bakker⁵, and Jos M. Raaijmakers^{1,§}. The abstract text is highlighted in yellow and reads: "Disease-suppressive soils are exceptional ecosystems in which crop plants suffer less from specific soil-borne pathogens than expected owing to the activities of other soil microorganisms. For most disease-suppressive soils, the microbes and mechanisms involved in pathogen control are unknown. By coupling PhyloChip-based metagenomics of the rhizosphere microbiome with culture-dependent functional analyses, we identified key bacterial taxa and genes involved in suppression of a fungal root pathogen. More than 33,000 bacterial and archaeal species were detected, with Proteobacteria, Firmicutes, and Actinobacteria consistently associated with disease suppression. Members of the γ-Proteobacteria were shown to have disease-suppressive activity governed by nonribosomal peptide synthetases. Our data indicate that upon attack by a fungal root pathogen, plants can exploit microbial consortia from soil for protection against infections."

The screenshot shows the ScienceDaily website interface. At the top, there is a navigation bar with "ScienceDaily" in a large font, followed by "Your source for the latest research news". Below this is a menu with "News", "Articles", and "Videos". Below the menu is a sub-menu with "Health & Medicine", "Mind & Brain", and "Plants & Animals". The main content area shows the article title "When Under Attack, Plants Can Signal Microbial Friends For Help" and the text "ScienceDaily (Oct. 24, 2008) — Researchers at the University of Delaware have discovered that when the leaf of a plant is under attack by a pathogen, it can send out an S.O.S. to the roots for help, and the roots will respond by secreting an acid that brings beneficial bacteria to the rescue." The text "roots will respond by secreting an acid that brings beneficial bacteria to the rescue" is highlighted in red.

- **Plants “Farm” or “Signal” disease-suppressing beneficial bacteria when under attack by pathogens.**
- **It’s important to maintain a diverse consortium of microbes.**

Beneficials As A Tool: Disease Control

Biologicals For Fungal and Bacterial Diseases

BRAND NAME	SPECIES	DISEASE/PEST TREATED
Serenade®	<i>Bacillus subtilis</i> (QST 713)	Blight, Botrytis, Rust, Powdery Mildew, Bacterial Spot...
Sonata®	<i>Bacillus pumilus</i>	Rusts, Downy & Powdery Mildews
Turf Shield®	<i>Trichoderma harzianum</i> Rifai <i>Trichoderma virens</i> G-41	Pythium, Fusarium, Rhizoctonia, Dollar Spot...
Cease®	<i>Bacillus subtilis</i> QST 713	Botrytis, Xanthomonas, Powdery Erwinia, Mildew, Leaf Spot, Rust...
Actinovate®	<i>Streptomyces lydicus</i> WYEC 108	Pythium, Phytophthora, Fusarium, Rhizoctonia...



Probiotics As A Tool: Disease Control

Late Blight (*Phytophthora infestans*) Disease Control



Best Practice

Biological Control (Bacteria)

Organic Input Options: Disease Control

Organic Chemical Disease Control Agents

BRAND NAME	CHEMICAL
Multiple	Copper (Kills Beneficials, Long Residual)
Multiple	Sodium Bicarbonate (Baking Soda). Overuse can cause sodium salt damage.
Milstop	Potassium Bicarbonate
PerPose Plus Oxidate	Hydrogen Peroxide/Dioxide*
Bonide Liquid Sulfur Lime Sulfur Spray	Sulfur (Residue Remains)
All Seasons Horticultural Oil	Horticultural Oils (i.e. Cinnamon). Can Burn.

***Hydrogen Peroxide is our preferred fungicide as it breaks down to water and oxygen (no residue) and preserves most beneficial organisms.**

Organic Pest Control:

- Insect, Grub, Tick



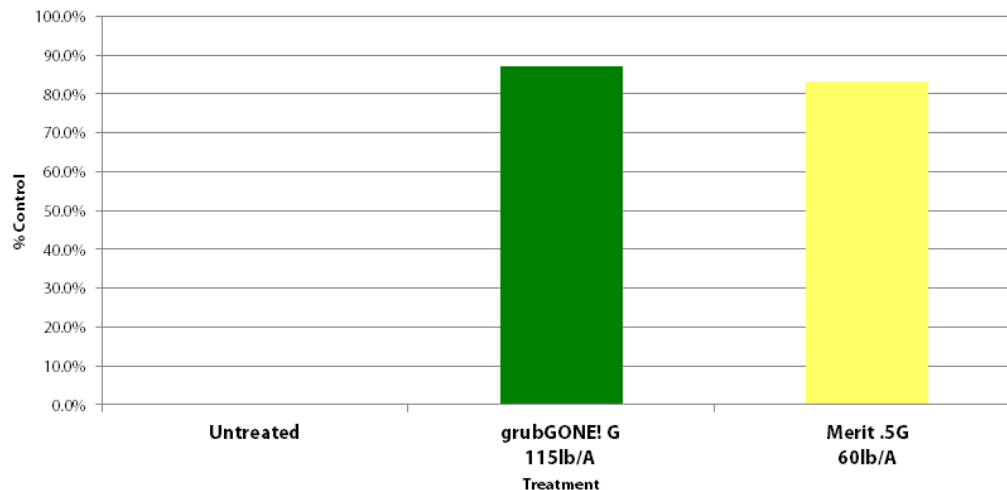
Organic Input Options: Grub Control Biologicals

grubGONE! & beetleGONE!

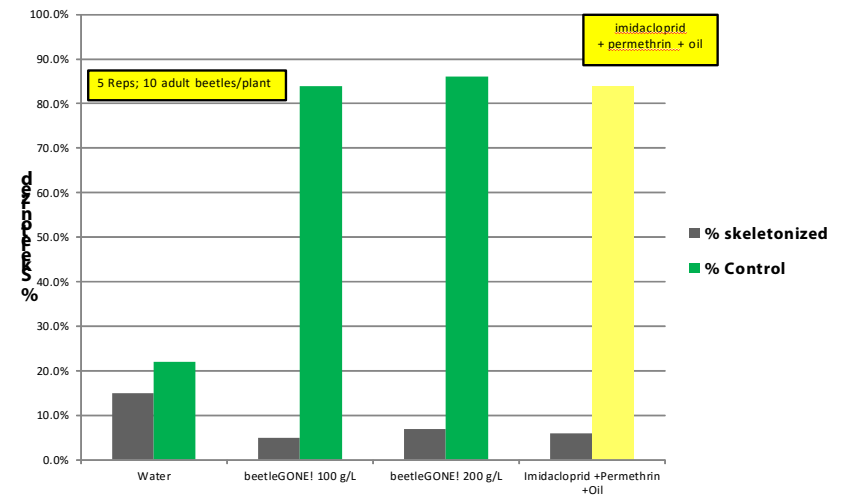
Bacillus thuringiensis galleriae (Btg)

- Novel & natural *Bacillus* strain that attacks beetle grubs in soil.
- Much broader range of control: Japanese, Oriental, June and Asiatic beetles; Chafers, Weevils & Emerald Ash Borers.
- Works on 1st to 3rd instar stages.
- Is effective in cooler temperatures than other biologicals.
- No affect against pollinators (bees), or other beneficials. **A true “Silver Bullet”.**

2009 Control of Oriental Beetle Grubs with Btg



beetleGONE! efficacy on Japanese Beetle Adult in Roses



Organic Input Options: Grub Control Biologicals – beetleGONE! & grubGONE!

The Big Picture: Grub Control, Neonics & Bees

By Richard S. Cowles, Ph.D.,
CAES Valley Lab

Of the Two Newer White Grub Insecticides, Which is Better?

From an ecological and long-term perspective, the 75% white grub control with grubGONE! reported by my turf entomologist colleagues may be preferable to the 100% control obtained with chlorantraniliprole (each when applied under perfect conditions).

My reasoning is that there are important parasites, predators, and diseases of white grubs, which if denied the presence of their hosts for multiple years at a site, will simply disappear.



Adoption of either of the new white grub insecticides (*Bacillus thuringiensis* var. *galleriae* and chlorantraniliprole), over the previous choices, is completely compatible with using the lawn as valued forage for pollinators, and eliminates one of the justifications (protecting bees from pesticides) for eliminating blooming plants from lawns.



Support CAES – Join the Experiment Station Associates

Interested in supporting the work of The Connecticut Agricultural Experiment Station? Considering joining the Experiment Station Associates. Members are invited to Station events and the annual meeting features speakers from CAES. They also produce a news bulletin covering the Station's scientific activities. This year they're working on tours of the CAES facility in New Haven. To find out more, follow them on Facebook at Experiment Station Associates or go to www.ct.gov/caes and click on "Experiment Station Associates."

Richard Cowles has worked at the Valley Laboratory of the Connecticut Agricultural Experiment Station since 1994. He focuses on finding practical solutions for managing important insect and mite pests.



Richard Cowles

Connecticut Gardener

July/August 2015

12



New Grub Control Product May Be a Game Changer



Photo courtesy of Kathy Connolly

By late May, beetles begin damaging the leaves of flowers and vegetables. This year, a new, non-toxic beetle and grub control product may tip the balance in favor of gardeners.

Kathy Connolly

Published April 30, 2015 4 a.m.



Organic Input Options: Biological Pest & Grub

Beneficial Nematodes



- Most nematodes feed on fungi and bacteria and are harmless to plants.
- Some require root feeding to complete their life-cycle (parasitic).
- Can be used as Biological Control Agents: Enter insect larvae and release bacteria (*Xenorhabdus* sp. bacteria) that kills the pest within 24-48 hours.
- Very broad spectrum biological insect control agent.
- Timing of pest larval stages and specific soil temperatures needed makes nematodes more effective for indoor growing. Very costly.

A healthy soil food web stimulates beneficial nematodes.



Organic Input Options: Pest Control

Beneficial Insects



Exploit the natural predators of pathogenic organisms:

"The enemy of my enemy is my friend"

- Ladybugs (*Hypodamia convergens*)
 - Eat aphids, mites and other insects.
- Parasitic wasps (i.e. families Ichneumonidae , Braconidae, Chalcididae)
 - Lay eggs inside a large array of pathogenic insect hosts and kill them.
- Praying Mantises (*Stagmomantis carolina*):
 - Predators of a wide variety of insect pests.



Beneficials As A Tool: Pest Control

Biologicals For Grub and Pest Control

BRAND NAME	SPECIES	DISEASE/PEST TREATED
grubGONE! [®] beetleGONE!	<i>Bacillus thuringiensis galleriae</i> (Btg)	All Scarab Beetles Adult & Grubs
Milky Spore [®]	<i>Paenibacillus popilliae</i>	Japanese Beetle Grubs Only
Sonata [®]	<i>Bacillus pumilis</i> strain QST 2808	<i>Bacillus pumilis</i> strain QST 2808
Mycotrol O [®]	<i>Beauveria bassiana</i>	Controls the nymphal and larval stages of multiple insects.
Multiple	Pheromones	Multiple. Attract and trap or disrupt mating.
Multiple	Nematodes (<i>Steinernema feltiae</i>)	Great for lawns, fields, pastures and orchards.
Multiple	Nematodes (<i>Heterorhabditis bacteriophora</i>)	Best for white grubs (lawn). Narrow temperature range.

Organic Input Options: Pest Control

Chemical Control Agents

CHEMICAL	Mode of Action
Pyrethrins (Chrysanthemum Extract)	No-Selective. Multiple insects. Harmful to beneficials
Oils - Multiple	Suffocate insects on contact. Less residual impact.
Neem Oil (Azadirachtin)	Active compound more effective than general oils.
Nicotine	Neuronal. Non-Selective. Multiple Insects. Bees?
Spinosad	Neuronal. Larval stages. Less harmful to beneficials.
Sulfur	Also for disease such as mildews.
Kaolin Clay	Irritates insects and disguises the host plant by coating it with a ghostly white film
Diatomaceous Earth	Composed of fossilized, one-celled organisms called diatoms. Has low mammalian toxicity.

**Use Insecticides with caution – even organic ones!
Harmful to beneficials such as bees!**

Organic Input Options: Pest Control

Off-Target Bee (Pollinator) Safety

PESTICIDE	NON-TOXIC	LOW TOXICITY	HIGHLY TOXIC
Insecticides/Repellants/Pest Barriers			
<i>Bacillus thuringiensis</i> (Bt)	Green		
<i>Beauveria bassiana</i>			Red
Boric Acid		Orange	
<i>Cydia pomonella</i> <i>granulosis</i>	Green		
Diatomaceous Earth			Red
Garlic	Green		
Insecticidal Soap ^a			Red
Kaolin Clay	Green		
Limonene ^a		Orange	
Neem ^a		Orange	
Horticultural Oil ^{a,b}			Red
Pyrethrins ^c			Red
Rotenone ^c			Red
Ryania/Ryanodine		Orange	
Sabadilla ^c			Red
Spinosad			Red
Herbicides/Plant Growth Regulators/Adjuvants			
Adjuvants		Orange	
Corn Gluten	Green		
Gibberellic Acid	Green		
Horticultural Vinegar		Orange	
Fungicides/Bactericides			
Copper		Orange	
Copper Sulfate			Red
Lime Sulfur ^a , Sulfur ^{c,d}		Orange	

Organic Input Options:

Organic Weed Control



Organic Input Options: Weed Control

Cultural & Mechanical Weed Control



Organic Input Options: Weed Control

Cultural - High Mowing At 3" Or More

From: University of Maryland "WHAT ABOUT WEEDS – PAST, PRESENT AND FUTURE"



High Mowing (3" or higher) reduces stress on turf, helps the soil retain water, allows more energy for root growth and reduces weeds!



Probiotics As A Tool: Weed Control

Weed Allelopathy Through Soil Biology Alterations

Crabgrass (*Digitaria sanguinalis*) Allelochemicals That Interfere with Crop Growth and the Soil Microbial Community

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FOOD CHEMISTRY**

Bin Zhou †, Chui-Hua Kong †‡, Yong-Hua Li ‡, Peng Wang †, and Xiao-Hua Xu §

J. Agric. Food Chem., 2013, 61 (22), pp 5310–5317

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Featured Research

Crabgrass' secret: The despised weed makes herbicide to kill neighboring plants

Summary: Contrary to popular belief, crabgrass does not thrive in lawns, gardens and farm fields by simply crowding out other plants. A new study has found that the much-despised weed actually produces its own herbicides that kill nearby plants.

...(the research team) isolated three chemicals from crabgrass that affect the microbial communities in nearby soil and did indeed inhibit the growth of staple crops wheat, corn and soybeans. "The chemical-specific changes in the soil microbial community generated a negative feedback on crop growth," the scientists said, noting that the chemicals also would have a direct toxic effect on other plants.

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Appl Microbiol Biotechnol. 2013 Jul;97(13):5659-68. doi: 10.1007/s00253-013-4885-y. Epub 2013 May 30.

Unravelling the beneficial role of microbial contributors in reducing the allelopathic effects of weeds.

Mishra S¹, Upadhyay RS, Nautiyal CS.

the dynamic nature of soil microbes should not be overlooked...the type of microflora in the surroundings plays a crucial role because it can interfere with its allelopathic nature. Such microbes could be of prime importance for biological control management of weeds reducing the cost and ill effects of chemical herbicides.



Probiotics As A Tool: Weed Control

Weed Allelopathy Through Soil Biology Alterations

Weeds are just plants that are growing where they are not wanted.
“Any plant or vegetation interfering with the objectives of people.”



***Both these lawns in Westchester County are 100% organic and use pre- & pro-biotic supplements – almost no weeds.**

- Deeper , thicker root growth pushes out weeds (secondary to good soil biology).
- Healthier soil favors turf (secondary).
- Less soil compaction with biologicals.
- Allelopathic effects of weeds overcome by supplementing beneficial biology?



Organic Input Options: Weed Control

Organic Chemical Control Strategies

- **D-LIMONENE:** *An extract from citrus peels (not citric acid). Dissolves waxy cuticle and dehydrates plants from root up. Safer than acids. Very effective.*
- **SALTS:** Common table to salts, potassium chloride etc...Generally desiccates weeds through osmosis – that is they pull water out of the tissue so the plants shrivel.
Generally Safe **Limited Effect – Misses Roots** **Corrosive**
- **VINEGAR (Acetic Acid):** Burns foliage like acid burns our skin. More effective with heat and sun.
 - 5% acetic acid safe but not as effective.
 - 10%-20% acetic acid more effective but can damage eyes, concrete.
- **OTHER ACIDS:** Citric acid,
- **SOAPS (Fatty Acids):** More efficacy and safety. Not “certified organic” now.
- **OILS:** Clove Oil, Cinnamon Oil etc...”Like a magnifying glass on a bug” oil enhance the effect of the sun and burn the leaf. Sun & Heat needed.
- **HEAVY METALS: Iron etc...**Expensive, High Potential for Staining, Does not kill roots. Requires multiple applications every 2-3 weeks. Generally Safe.



Organic Input Options: Weed Control

Organic Chemical Control Agents

BRAND NAME	CHEMICAL	SELECTIVE / NON-SELECTIVE
Avenger [®]	D-Limonene	Non-Selective
BurnOut II	Citric Acid, Clove Oil	Non-Selective
Weed Works Weed & Grass Killer	20% Vinegar (Acetic Acid)	Non-Selective
Scythe [®]	Pelargonic Acid and Related Fatty Acids	Non-Selective
A.D.I.O.S. [™]	Salt - Sodium Chloride 96.6%	Selective?
Fiesta [®]	Iron HEDTA (FeHEDTA) 26.5%	Selective?
Various Brands	Corn Gluten (9-0-0)	Selective?

Effective Selective Weed Control is the “Holy Grail” of Organics.



Organic Myths





Pseudo-science: a threat to agriculture?

22/04/2014 12:30 PM

Pseudo-science: a threat to agriculture?

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*'On what principle is it that when we see nothing but improvement behind us,
we are to expect nothing but deterioration before us.'*

Thomas Macaulay 1830

Abstract: *The case for agricultural science is asserted, but in the context that science is under threat in contemporary society because of the adoption of post-modern philosophies which give credibility to pseudo-science and give rise to what is now being described as Post-Normal Science. The author examines the question – Is there a legitimate argument to take to science managers, scientists, politicians and society to say pseudo-science is dangerous and should not be tolerated? It is concluded that science must be asserted and it must regain its proper moral high ground in society. To achieve this there must be changes to science policy and to how science is managed. Science, at least government (publicly) funded science, must be returned to its normative function.*



Organic Myths: Compost Teas

horticultural myths



Linda Chalker-Scott, Ph.D.
Extension Horticulturist
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Washington State University

Compost tea: Examining the science behind the myth

WSU Master Gardeners are often asked about compost tea (and other products) but may not have ready access to objective information. This column is dedicated to those hard-working volunteers who want the current best science on products and practices so that they can continue to learn and inform others.

Can WSU Master Gardeners recommend compost tea use?

The short answer is no. Because WSU Master Gardeners are volunteer educators who rely on science-based information, they cannot recommend a practice or product that lacks a legitimate scientific basis. Furthermore, it is illegal to sell unregistered substances for use as pesticides. There are no compost tea products registered as pesticides with the U.S. Environmental Protection Agency. Neither WSU Master Gardener volunteers nor Web sites may encourage the use of compost tea as a pesticide.

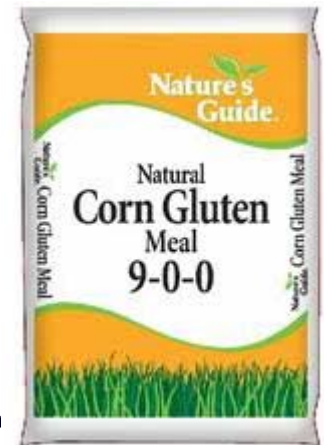
If compost tea doesn't do anything, then how can it hurt to apply it?

Compost teas lack university studies and proof of efficacy.



Organic Myths: Corn Gluten

- Corn Gluten can be derived from corn grown using herbicides and transfer these properties.
- A good source of organic Nitrogen, but can cause excessive growth and nutrient runoff when applied at recommended rates.
- Failed to control weeds effectively in many studies:
 1. Dernoden, 1996-1998, 2009-2010. Corn Gluten was not effective as a pre-emergent. University of Maryland
 2. An OSU study by Carol Savonen demonstrated that Corn gluten meal did not prevent weeds from germinating.
 3. Washington State University researchers at the Mt. Vernon station found no differences in weed control on field-grown strawberries, though yield was slightly improved.
 4. An Iowa State group had similar disappointing results in their strawberry trials, with no significant differences in either weed control or strawberry yield even after multiple treatments with CGM.



Corn Gluten has a questionable scientific basis for herbicide use at best. Recommended rate of 30lb/1,000sf causes runoff and pest/disease issues.

Organic Myths: Compost Is Completely Harmless

Compost or vermicompost (worm castings) are great organic nutrient sources...if from a reputable source and used correctly.

- If you compost your own waste, then the “carbon load” makes sense. If you bring in compost, many hydrocarbon inputs may be used to process and transport the compost.
- Compost can have a “P” value and be illegal to put down without a soil test.
- Compost reduces down significantly. The nitrogen and carbon gases off, but the salts do not. A real burn potential.
- What goes in comes out: Is the compost free of pesticides and chemicals?
- Is the ratio of composted materials correct? Too much N or K?



Organic Myths: Compost Is Completely Harmless



A Massachusetts lawn that was treated professionally with unfinished compost 24 hr. earlier from a professional source.

Organic Myths: Gypsum

For salt damage and toxicity - such as that associated with the recent hurricanes along The Sound or excess fertilizer and pesticide use, gypsum is often used for remediation.

“Many coastal Connecticut residents have contacted the University of Connecticut Soil Nutrient Analysis Laboratory because of their concerns of salt contamination from either flooding or storm surges.

...Gypsum is not especially effective except in limited circumstances.”

UConn Home & Garden Education Center

Knowledge to Grow On!

www.ladybug.uconn.edu





How To Grow Organically In A Few Easy Steps



Growing Organically: Strategies for Integration

- 1) Soil test. Target Nutrients to the needs of the crop and the soil. Saves money and is better for the environment.**
- 2) Use methods and products that stimulate soil biology, not those that destroy it.
- 3) Use IPM Standards – The least harmful approach first – even with organic products.
- 4) Healthy plant & turf growth with organic practices will have much less disease and pest pressure



Probiotics As A Tool: Strategies for Integration

How to stimulate or supplement microbes in your landscape or lawn care practice:

- 1) Bio-stimulation (inducing microbes):
 - a) Induce the growth of endogenous microbes (Pre-biotics).
 - b) Don't destroy the natural flora that is already there!
- 2) Bio-supplementation (adding microbes).
 - a) Compost & Worm Castings.
 - b) Controlled biological inoculants.



Probiotics As A Tool: Strategies for Integration

Practices and commonly used inputs that adversely affect soil microbiology:

- **Tilling**: Destroys the complex organization of the rhizosphere and the crucial top layer of soil.
- **Roundup® (Glyphosate)**: Roundup can reduce beneficial organism populations (*Pseudomonas fluorescens*) and cause increases in pathogen growth (*Fusarium*).
- **Fungicides & Antibacterials**: Kill fungi and bacterial populations in a non-specific manner.
- **Insecticides**: Can cause secondary effects on beneficial insect populations (colony collapse disorder).
- **Excess Fertilization**: Phosphate is toxic to beneficial organisms at high concentrations. Excess nutrients will stimulate pathogen growth.



Results: Organics on Plants, Trees & Turf

Lettuce – Subway Food Chain



Best Practice

Soil Probiotics

(Lettuce grown for the Subway food chain)



Results: Organics on Plants, Trees & Turf

Christmas Tree Farm – Higganum Connecticut



Best Practice

Avg. pounds per acre: **8,800**

Soil Probiotics

Avg. pounds per acre: **11,424**

30% Increase in Yield!



Results: Organics on Plants, Trees & Turf

GLTi Green Walls – Carrots & Potatoes

Carrots



Best Practice

Soil Probiotics

Potatoes



Best Practice

Soil Probiotics

“I wanted to share some of our own data...the potatoes and carrots are bigger than those not treated...clearly not even close! I just wanted to keep you in the loop hopefully we can be your retirement fund!”

George Irwin, Founder - Green Living Technologies (A Green Wall)



Results: Organics on Plants, Trees & Turf Orchids



**Den. Thongchai Gold and Den. Krating Daeng. 3 months post-treatment.
EverGrow Garden Center, Jamaica.**



Results: Organics on Plants, Trees & Turf

Turf – Franklin, CT Landscaper



The treated area on the right had a standard, synthetic nutrient program plus synthetic polymers. It also was irrigated – the turf on the left with pro- & pre-biotics was not.

...Steve Bousquet, American Lawn Science, Franklin CT



Results: Organics on Plants, Trees & Turf

Turf – NFL Stadiums

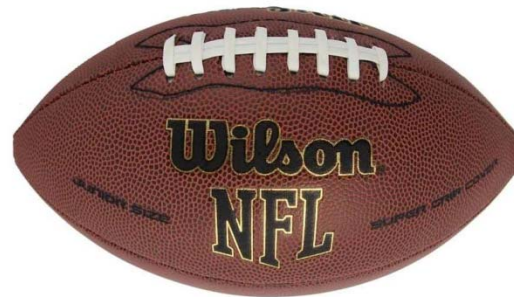
Raymond James Stadium, Tampa Bay Buccaneers



Before Treatment



1 Week After Soil Probiotics



Results: Organics on Plants, Trees & Turf

Blueberries (Woody Ornamentals)



Best Practice

Soil Probiotics

Test results on the use of Quantum Growth products 3 weeks after 1st app.

"Your soil probiotic products worked equally well with all our varieties!"



Results: Organics on Plants, Trees & Turf

Christmas Tree Farm – Higganum Connecticut

April 2010 - Application of 1st Quantum Growth Treatment



June 2010 - After 2 Quantum Growth Treatments



Results: Organics on Plants, Trees & Turf

Soil Reclamation & Remediation



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