#  Horticultural Zombies – How to recognize and dispatch

# *Seminar roadmap*

# Sources of information

# Evaluating information

# Assessment examples

#### Products

#### Practices

# Good and not-so-good science

# *Sources of information*

# Scientific – peer reviewed, academic audience

# Gray – not peer reviewed, professional audience

# Popular – not peer reviewed, general audience

# *Evaluating information using the CRAP test*

## **C**redibility of the source

#### Author's credentials and qualifications?

#### Publisher?

#### Website urls?

## **R**elevance to managed landscapes

#### Crop production or urban landscapes?

#### Geographic or other constraints on usability?

## **A**ccuracy

#### Science-based?

#### Objective?

#### Current?

#### Well-written?

## **P**urpose

#### Educational or commercial?

#### Political, ideological, cultural, religious, or personal biases?

#### When in doubt, consult with relevant discipline experts

# *Assessment of products and practices*

# No supporting science (no research; inconsistent or negative results; poor quality research or reporting)

# Misapplied science (agricultural products and practices applied to nonagricultural settings)

# Overextrapolated science (products and practices with limited efficacy applied to settings outside the efficacy window)

# No consistent, reliable supporting science

# Products

#### Balanced fertilizers

#### Compost tea

#### Conditioners

#### Kelp products

#### Organic product superiority

#### Vitamin B-1 transplant fertilizer

#### Wound dressings

# Practices

#### Avoiding hot weather watering

#### Biodynamics

#### Companion planting

#### Hügelkultur

#### Lasagna mulching

#### Leaving rootballs intact

#### Native plant superiority

#### Permaculture

## Because none of these products or practices are supported with sufficient scientific evidence, they should not be used or recommended.

## Claim: Use balanced fertilizers to support garden and landscape plants

## Fact: Fertilizers are frequently overused and misused in home gardens and landscapes

# Imbalances and toxicities disrupt uptake of other nutrients

# Beneficial microbes are negatively impacted

# Heavy metals build up rapidly

# Only a soil test can tell you what your soils needs

## Claim: Compost tea fights plant diseases and improves soils

# Science behind compost tea and disease

#### In general, mixed results in the lab and the field in controlling disease

#### ACT less effective than NCT in controlling pathogens

#### ACT not only ineffective, but in some cases make problems worse

# Science behind ACT and soils

#### Few studies published

#### Virtually no differences between soil treated with water and ACT

#### Compost has much greater nutrient content and many more microbes than ACT

# Scientific summary

#### ACTs have no value in disease control or as a fertilizer

#### ACTs are not legal pesticides

#### ACTs can contain pathogens

#### ACTs are expensive and energy-wasteful compared to compost

## Claim: Conditioners will “reduce soil compaction, help clay conditions, improve drainage and aeration, and bioactivate soils”

# About conditioners

#### Active ingredient is often ammonium laureth sulfate: a surfactant or soap

#### Anything with a waxy protective covering will be injured or killed by conditioners

## Claim: Kelps and seaweeds stimulate root growth and plant establishment

# About kelp

#### The “trees” of marine ecosystems

#### Clearcut to make garden products

#### Kelp harvesting affects fish and coastal seabird populations

# Scientific summary

#### Weak fertilizer

#### Kelp hormones can stimulate rooting

#### Generally no different than controls in greenhouse and field experiments

#### When compared to well-watered, fertilized plants, there are no differences

## Claim: Organic products are superior to “chemicals”

## Fact: Everything, natural or otherwise, is composed of chemicals

## Scientific summary

## Organic: In chemistry, this is any chemical compound composed of C, H, and O

## Organic farming: partially defined as using only naturally occurring chemicals

## Recommendations

## Start with a soil test

## Avoid using any chemical unless a soil test indicates a deficiency

## Claim: Vitamin B-1 will help transplants establish

# About Vitamin B-1

#### Plants make their own

#### Rooting hormones are more effective

#### Additional minerals in products unnecessary

## Claim: Wound dressing will protect wounds and enhance their healing

# About wound dressing

#### Components include petrochemicals

#### Application interferes with natural sealing

#### Restricts oxygen

#### Prevents wound wood formation

#### Inhibits compartmentalization

#### Increases disease

#### Seals in decay

#### Does not keep pathogens out

#### Does not stop rot

## Claim: Watering during the hottest part of the day will scorch leaves

## Water drops on the leaf surfaces act as tiny magnifying glasses

## Wet leaf surfaces are more likely to burn than dry ones

## Fact: Other factors can cause scorch, but not water

## Symptoms of water deficit:

## tip and marginal leaf scorch, early leaf abscission

## shoot dieback and stunted growth

## Causes of water deficits – all linked to decreased leaf water:

## Soil issues: lack of water, presence of salts, compaction, flooding

## Weather issues: lack of rainfall, high temperature, high light, wind

## Plant issues: poor root health (improperly prepared roots)

## Recommendations

## Maintain adequate soil moisture, oxygen, temperature, and nutrients

## Watch foliage for signs of wilt and water immediately

## Do not overuse fertilizers and pesticides

## Run recycled or grey water through a filtering system before applying it to plants

## Claim: biodynamics stimulate vitalizing and harmonizing processes in the soil

# About biodynamics

#### Philosophy based in alchemy, astrology, and homeopathy

#### Scientific inquiry rejected by inventor

#### No differences on plants or soil between organic methods and biodynamics

# Vine nutrition and winegrape analyses – results

#### “Based on the fruit composition data, there is little evidence the biodynamic preparations contribute to grape quality.”

#### “The differences observed were small and of doubtful practical significance.”

# Vine nutrition and winegrape analyses – abstract

####  “…the biodynamic treatment had ideal vine balance for producing high-quality winegrapes…”

#### “Biodynamically treated winegrapes had significantly higher (p < 0.05) Brix and notably higher (p < 0.1) total phenols and total anthocyanins in 2003.”

## Claim: Companion plants “use tables to select compatible species”

# About plant associations

#### Three Sisters

#### Polyculture and intercropping

#### Phytoremediators

#### Nitrogen fixers

#### Nurse plants

# NOT: astrological charts for gardeners

## Claim: Hügelkultur is an ancient way to grow vegetables sustainably

# About Hügelkultur

#### Invented by a German gardeners and published in a booklet in the 1960’s

#### Promotes a method that doesn’t occur in natural systems

#### Is inherently unstable and therefore not sustainable

## Claim: Lasagna mulching creates a healthy, nutrient rich soil

# About lasagna mulching

# “a no-till method of layering brown and green materials to increase organic matter”

# Emotional appeal

# Scientific summary

# Sheet mulches reduce water and air availability to roots

#### Overuse of any nutrient can create soil, plant and water problems

## Claim: Root balls must be left intact during transplanting

# About B&B and container root balls

#### Surrounded by clay or soilless media

#### Often too deeply buried

#### Often have fatal root flaws

# Scientific summary on bare rooting

#### Eliminates multiple barriers to root establishment (burlap, clay, etc.)

#### Allows detection and correction of root flaws

#### Guarantees planting at grade

## Claim: Native species are the best choices to support landscape biodiversity

## Facts:

# Definitions of “native” and “alien” are value judgments, not scientific terms

# Not all introduced species are invasive

# Urban areas do not have natural environmental conditions

# Native species are often not adapted to urban conditions

# Introduced species provide ecological benefits

# Vegetation diversity, structure and function more important to biodiversity than nativeness

# Claim: Permaculture is an ecology-based approach to gardening

## Facts:

# Permaculture is a philosophy-based approach to gardening

# Includes scientific-sounding terms that are meaningless or incorrect (i.e., pseudoscience)

#### Dynamic nutrient accumulators, narcissistic plant species

#### Buffer plants, guilds

# Practices are not science-based and are damaging to plant and soil health

#### Sheet mulching

#### Recommended use of noxious weeds and other invasive species

# Misapplied science

# Products

#### Antitranspirants

#### Epsom salts

#### Gypsum

#### Hydrogels (“water crystals”)

#### Phosphate fertilizer

# Practices

#### Amending soil before planting

####  Foliar fertilizers

## Claim: Antitranspirants “block out insects and disease, and lock in moisture during stress”

# About antitranspirants

#### Cover leaf surfaces, including stomates

#### Reduce water and gas movement between the leaf and atmosphere

# Scientific summary

#### May reduce insect attack but not disease

#### May work in weed control

## Claim: Epsom salts are a “safe, natural way to increase plant growth”

# About Epsom salts

#### Magnesium sulfate

#### Originally from Epsom, England

#### Makes water feel silkier

# Scientific summary

#### Generally used to treat magnesium deficiency in production agriculture

#### Adding magnesium to soils with adequate magnesium can cause nutritional imbalances

## Claim: “Adding gypsum to your yard or garden will improve soil tilth”

# Gypsum can:

#### Replace sodium in salty soils with calcium

#### Improve heavy clay soils

#### Improve agricultural soils

# Gypsum will not:

#### Change acidic or sandy soils

#### Improve water holding capacity

#### Improve most urban soils

#### Help plants establish

## Claim: Water crystals protect plants in heat-stressed, drought-prone situations, by absorbing water, then releasing it gradually as plants need it”

# About hydrogels

#### Acrylamide polymers

#### Absorb large amounts of water

#### Used in cosmetics, disposable diapers, tissue enhancement

# However, water crystals

#### …are broken down quickly by microbes, sunlight and fertilizers, so…

#### …are only a temporary fix to droughty soil conditions

# Scientific summary

#### Variable effectiveness in field studies; no long term benefit

#### As crystals dry out, they absorb water from the soil

#### Studies have found mulches to be more cost-effective

## Claim: phosphate fertilizer enhances root growth of new transplants

# About phosphorus

#### Most urban soils have enough phosphorus

# Scientific summary

#### Phosphorus competes with iron and manganese uptake

#### Excess phosphorus Inhibits mycorrhizal fungi, so roots work overtime

#### Excess phosphorus pollutes aquatic systems

## Claim: before planting trees and shrubs, work in organic material to improve soil

# Based on an agricultural model for intensive crop production

# Scientific summary

#### Hydrology disruption

#### Soil subsidence

#### Nutrient overload

## Claim: foliar feeding puts fertilizer directly onto leaves rather than wasting it on the soil

# Scientific summary

#### Foliar fertilizers only treat foliar symptoms; they don’t solve soil deficiencies

#### Repeatedly applying foliar fertilizers is expensive and can injure plants

# Overextrapolated science

# Corn gluten meal (CGM)

# Harpin

# Mycorrhizal and probiotic inoculants

## Claim: corn gluten meal controls weeds

# About corn gluten meal

#### Natural, pre-emergent herbicide registered for turf use

#### High (10%) nitrogen by-product of corn milling

#### CGM inhibits seedling development, by drying the soil and reducing water availability

#### Soil must remain dry during seedling development

#### Effectiveness is species specific

# Scientific summary

#### Greenhouse trials demonstrate effectiveness

#### Field trials less successful

#### Little effect on container weeds

#### No control of turf grass weeds

#### No control of crop field weeds

#### Soil must be dry in late spring

#### Spring is the wettest season in the coastal western US

#### CGM is not successful in this and similar climates

#### High nitrogen content of CGM acts like a fertilizer

## Claim: harpin is like a vaccination that turns on a plant’s defenses

# About harpin

#### A protein isolated from the bacterium that causes fire blight

#### Triggers plant systemic immune response

#### Must be taken up into the intercellular spaces

# Scientific summary

#### Laboratory work

#### Successful in cell cultures

#### Greenhouse and field work

#### A few crops and fruit trees studied

#### No consistent disease control

#### No studies on any landscape plants

#### Lab results often don’t transfer to field application

#### Cell cultures are not equivalent to whole plants

## Claim: mycorrhizal inoculants improve root growth and plant establishment

# Scientific summary

#### In the greenhouse

#### Inoculants can work in container plant production to “jump start” sterile media

#### In the landscape

#### Healthy soils have their own populations of mycorrhizae

#### Unhealthy soils won’t support mycorrhizae

## Science-based alternatives:

# Avoid applications of any chemicals before thorough diagnosis of landscape problems

# Test soils before adding any amendments

# Add organic material as “slow food” after planting

# Use coarse woody mulches

# Control weeds

# Add nutrients slowly

# Do not restrict water and gas movement

# Protect and enhance soil health

# Support native populations of beneficial microbes

# *Good and not-so-good science*

# 1. Good quality research but poor reporting

# Often due to researcher bias

# Selective highlighting of results (often with statistical errors) in the abstract or summary

# Downplaying or omitting other results

## Claim: Mulching newly transplanted trees will increase evaporation

# Gilman, E.F., R.C. Beeson and D. Meador. 2012. Impact of mulch on water from a container substrate and native soil. *Arboriculture and Urban Forestry* 38(1):18-23.

# 2. Poor quality research

# Common with authors with no expertise in field

# Conflating correlation with causation

#### A [correlation](http://en.wikipedia.org/wiki/Correlation_and_dependence) between two variables does not mean that one [causes](http://en.wikipedia.org/wiki/Causality) the other

#### Controlled studies can determine causation but not always feasible

#### Correlations can be valuable, but only if examined rigorously and eliminating other possible causes of the observed phenomenon

## Claim: Glyphosate causes human diseases

# Samsel, A. and S. Seneff, 2013. Glyphosate’s suppression of cytochrome P450 enzymes and amino acid biosynthesis by the gut microbiome: pathways to modern diseases. *Entropy* 15:1416-1463.

Look at the body of research. If a paper is at odds with the majority of other papers, it must withstand increased scrutiny.

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# URL: <http://www.theinformedgardener.com> (white papers on many of these myths)

# Blog: http//www.gardenprofessors.com

# Books: http//www.sustainablelandscapesandgardens.com

# Facebook page: <http://www.facebook.com/TheGardenProfessors>

# Facebook group: <https://www.facebook.com/groups/GardenProfessors/>

# Washington State University Extension publications: <http://gardening.wsu.edu/>(peer-reviewed fact sheets on many topics of interest)

Fact sheets referred to in this presentation:
Corn meal and corn gluten meal - <https://pubs.extension.wsu.edu/cornmeal-and-corn-gluten-meal-applications-in-gardens-and-landscapes-home-garden-series>

Epsom salt – <https://pubs.extension.wsu.edu/epsom-salt-use-in-home-gardens-and-landscapes>

Gypsum - <https://pubs.extension.wsu.edu/gypsum-use-in-home-gardens-and-landscapes>

Hügelkultur - <https://pubs.extension.wsu.edu/hugelkultur-what-is-it-and-should-it-be-used-in-home-gardens>

Kelp products - <https://pubs.extension.wsu.edu/the-efficacy-and-environmental-consequences-of-kelp-based-garden-products>

Mycorrhizae - <https://pubs.extension.wsu.edu/a-gardeners-primer-to-mycorrhizae-understanding-how-they-work-and-learning-how-to-protect-them-home-garden-series>

Native vs. nonnative trees and shrubs - <https://pubs.extension.wsu.edu/are-native-trees-and-shrubs-better-choices-for-wildlife-in-home-landscapes>

Scientific literacy - <https://pubs.extension.wsu.edu/scientific-literacy-for-the-citizen-scientist>

Wood chip mulches - <https://pubs.extension.wsu.edu/using-arborist-wood-chips-as-a-landscape-mulch-home-garden-series>